US Army Corps
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LOWER SNAKE RIVER ICE HARBOR and LOWER MONUMENTAL LOCKS and DAMS

Adult Fishway Systems Emergency Auxiliary Water Supply Phase II - Technical Report

August 1999

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In response to a Endangered Species Act-Section 7 Consultation, Biological Opinion issued by the National Marine Fisheries Service on March 2, 1995, the Lower Snake River, Adult Ladder Systems, Emergency Auxiliary Water Supply (Phase I-Technical Report), 1995, evaluates the need for emergency auxiliary water supplies for the adult fishway systems at Ice Harbor and Lower Monumental Locks and Dams (Ice Harbor and Lower Monumental). This Emergency Auxiliary Water Supply, (Phase II-Technical Report) describes and evaluates the existing systems at Ice Harbor and Lower Monumental, outlines alternatives for improving the reliability of the existing auxiliary water supplies, and explores several design options for providing emergency capacity with pumped and gravity supply systems.

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LOWER SNAKE RIVER

ICE HARBOR AND LOWER MONUMENTAL LOCKS AND DAMS

ADULT FISHWAY SYSTEMS

EMERGENCY AUXILIARY WATER SUPPLY

PHASE II - TECHNICAL REPORT

August 1999

U.S. Army Corps of Engineers
Walla Walla District

LOWER SNAKE RIVER
ICE HARBOR AND LOWER MONUMENTAL PROJECTS
ADULT FISHWAY SYSTEMS--EMERGENCY AUXILIARY WATER SUPPLY

PHASE II - TECHNICAL REPORT

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

SECTION 2 - ICE HARBOR (Continued)

TABLE OF CONTENTS (Continued)

SECTION 2 - ICE HARBOR (Continued)

TABLE OF CONTENTS (Continued)

SECTION 2 - ICE HARBOR (Continued)

SECTION 3 - LOWER MONUMENTAL

TABLE OF CONTENTS (Continued)

SECTION 3 - LOWER MONUMENTAL (Continued)

SECTION 4 – ENVIRONMENTAL REQUIREMENTS

TABLE OF CONTENTS (Continued)

TABLES

GLOSSARY

PLATES

TABLE OF CONTENTS (Continued)

PLATES (Continued)

APPENDIXES

LOWER SNAKE RIVER
ICE HARBOR AND LOWER MONUMENTAL LOCKS AND DAMS
ADULT FISHWAY SYSTEMS
EMERGENCY AUXILIARY WATER SUPPLY

PHASE II - TECHNICAL REPORT

EXECUTIVE SUMMARY

In response to a *Endangered Species Act - Section 7 Consultation, Biological Opinion* issued by the National Marine Fisheries Service on March 2, 1995, the *Lower Snake River, Adult Ladder Systems, Emergency Auxiliary Water Supply* (Phase I - Technical Report), 1995, evaluates the need for emergency auxiliary water supplies for the adult fishway systems at Ice Harbor and Lower Monumental Locks and Dams (Ice Harbor and Lower Monumental). This Emergency Auxiliary Water Supply, Phase II - Technical Report (Phase II - Technical Report) describes and evaluates the existing systems at Ice Harbor and Lower Monumental, outlines alternatives for improving the reliability of the existing auxiliary water supplies, and explores several design options for providing emergency capacity with pumped and gravity supply systems.

ICE HARBOR.

The adult fishway systems at Ice Harbor consist of separate fish ladders and collection systems on both the north shore and south shore. Each system has a fish ladder, collection system, and an auxiliary water supply system. The south shore system also has a collection channel along the downstream face of the powerhouse, with floating orifices that provide additional points of access. The auxiliary water supply system on the north shore uses three, electric motor-driven pumps to provide auxiliary water. The auxiliary water supply system on the south shore uses eight, electric motor-driven pumps to provide auxiliary water. The juvenile bypass system also provides some auxiliary water for the south shore system.

- North Shore.

The north shore system has three pumps that must operate continuously to attempt to satisfy the criteria of the *Fish Passage Plan* (FPP), U.S. Army Corps of Engineers, March 1998. No spare water supply capacity is available if one of the auxiliary water supply pumps requires maintenance. Ice Harbor does not have a complete set of spare parts for the water supply pump system. The pump discharge chamber is constructed such that individual pumps cannot be isolated for maintenance. The pressure drop in the water supply system increases at low tailwater and prevents the pumps from producing their design flow. Crane access for maintaining the pumps and fishway entrances is difficult and time-consuming. The pumps are started using

breakers instead of starters and do not have redundant power sources. A single electrical failure could result in all three pumps going out of service.

The following five alternatives were considered for improving the reliability of the existing water supply system or providing an additional emergency water supply: (1) criteria revision with no water supply additions, upgrade electrical, and improve systems; (2) upgrade existing pumps, upgrade electrical, and improve systems; (3) add gravity supply, upgrade electrical, and improve systems; (4) barge mounted pumps shared with Lower Monumental; and (5) reduce entrance width, upgrade electrical, and improve systems.

Alternative 2 is the recommended alternative. The existing pumps and electrical power supplies would be upgraded. The pump appurtenances would be rebuilt to keep them operable. Isolation bulkheads would be installed to allow maintenance and repair of the pumps. The supply diffusers would be modified to allow more flow. A crane would be installed to perform maintenance on the upgraded pumps and appurtenances. A hoist would be installed at the fishway entrances to allow maintenance of the entrance gates and weirs. Project Operations would obtain additional operation and maintenance (O&M) funds to maintain or replace deficient components of existing features and to increase spare parts inventories for fishway critical components.

Alternative 3 would provide only partial backup, so the existing pumping system would need to remain operational under any circumstances. Alternative 3 would also involve greater expense and increased maintenance. Alternatives 1 and 5 would result in a decrease in the quantity of water supplied, which is contrary to the intent of this study. Alternative 4 has serious safety and operability concerns.

If funding for design and construction is made available at the beginning of Fiscal Year (FY) 2000, the design and construction period for Alternative 2 will require approximately 36 months with all modifications complete by October 2002. Total construction costs for Alternative 2, escalated to the midpoint of construction, are estimated to be $5,182,000. The total costs for the fully-funded Alternative 2 are estimated to be $7,178,000. These costs do not include O&M costs associated with existing equipment.

- <u>South Shore</u>.

The south shore system is operated using six to eight pumps, depending on tailwater elevation. Spare water supply capacity has ranged from 0.6-pump equivalent (based on the water from the juvenile fish dewatering facility) up to an additional 2-pump equivalent. Therefore, additional spare hydraulic capacity is not required on the south shore. Ice Harbor does not have a complete set of spare parts for the pump system. The pumps are started using breakers instead of starters and do not have redundant power sources. A single electrical failure could result in all eight pumps going out of service.

The following three alternatives were considered for improving the reliability of the existing water supply system: (1) electrical system upgrade; (2) improve reliability through enhanced preventative maintenance and increased spare parts inventory; and (3) combine Alternatives 1 and 2, electrical system upgrade and enhanced preventive maintenance and increased spare parts inventory.

Alternative 3 is the recommended alternative. Under this alternative, the pump electrical systems would be upgraded and an enhanced preventative maintenance program would be employed with an increased spare parts inventory. This alternative addresses the electrical reliability issue and the continued use of existing equipment with increased preventative maintenance and spare parts. Also, as described previously, this alternative would provide between 0.6 pump equivalent and 2-pumps equivalent of spare auxiliary water supply. Alternatives 1 and 2 do not individually address these issues.

If funding for design and construction is made available at the beginning of FY 00, the design and construction period for the construction general portion of Alternative 3 will require approximately 60 months with all modifications complete by October 2004. There would be a 2-year delay following design before start of construction to ensure that the north shore auxiliary water supply system was operational before performing construction on the south shore auxiliary water supply system. Total construction costs for the construction general portion of Alternative 3, escalated to the midpoint of construction, are estimated to be $2,109,000. The total costs for the fully-funded construction general portion of Alternative 3 are estimated to be $2,921,000. These costs do not include O&M costs associated with existing equipment.

LOWER MONUMENTAL.

The adult fishway systems at Lower Monumental consist of separate fish ladders and collection systems on both the north and the south shores. A common auxiliary water supply system supplies water to both fishways. The north shore fishway also has a collection channel along the downstream face of the powerhouse, with floating orifices that provide additional points of access. The auxiliary water supply system uses three hydraulic turbine-driven pumps to provide auxiliary water. The juvenile bypass system also provides some auxiliary water.

All three north shore pumps operate full-time attempting to meet the FPP criteria. There is no emergency auxiliary water supply available to sustain operation within criteria in the event of a pump failure. The actual pump performance does not appear to match the manufacturer's pump curves and is substantially less than required to provide the intended design flow. The turbine pumps are gravity fed and require only low-voltage electrical power. Individual pump chambers can be isolated and dewatered for maintenance by using the intake and discharge bulkheads.

The following six alternatives were considered for improving the reliability of the existing water supply system and for providing additional emergency water supply: (1) south shore pumping system; (2) gravity supply through south nonoverflow section; (3) south shore supply conduit inline pumping system; (4) additional north shore pumps, (5) enhanced preventative maintenance; and (6) barge mounted pumps shared with Ice Harbor.

Alternative 3 is the recommended alternative. This alternative would separate the north shore system from the south shore system. It would replace the existing regulating tainter gate in the south shore fish ladder supply conduit with one or more new inline pumps. New openings cut in the side of the south shore water supply conduit (near unit 6) would supply water to these pumps. These openings would be provided with power operated bulkheads and trashracks. The north shore entrances would continue to use two of the existing hydraulic turbine-driven pumps, with one in reserve. In the event of an inline pump failure, bulkheads could be powered into place and the inline pumps removed to allow the existing reserve hydraulic turbine-driven pump to provide emergency water. Project Operations would obtain additional O&M funds to maintain or replace deficient components of existing features and to increase spare parts inventories for fishway critical components.

Alternative 1 would have potential intake problems, because the water would be pumped from an area downstream of the fish ladder entrance and would be more populated with juveniles. The system would require trashracks and extensive intake screens that would need continuous maintenance and cleaning. Access to the pump area is limited and a dedicated crane would be required to allow quick repairs. Alternative 2 would provide only partial backup, so the existing pumping system would need to remain operational under any circumstances. It would involve greater installation expense and increased maintenance more than the other alternatives. Alternatives 1, 2, and 3, where the north shore and south shore would be divided into two separate auxiliary water supply systems are more effective than Alternative 4. Alternative 5 would not provide a source of emergency auxiliary water because all the existing auxiliary water supply pumps must be operated full time. Alternative 6 has serious safety and operability concerns.

If funding for design and construction is made available at the beginning of FY 00, the design and construction period for Alternative 3 will require approximately 36 months with all modifications complete by October 2002. Total construction costs for Alternative 3, escalated to the midpoint of construction, are estimated to be $6,267,000. The total costs for the fully-funded Alternative 3 are estimated to be $8,681,000. These costs do not include O&M costs associated with existing equipment.

LOWER SNAKE RIVER
ICE HARBOR AND LOWER MONUMENTAL LOCKS AND DAMS
ADULT FISHWAY SYSTEMS
EMERGENCY AUXILIARY WATER SUPPLY

PHASE II - TECHNICAL REPORT

SECTION 1 - INTRODUCTION

1.01. GENERAL.

The National Marine Fisheries Service (NMFS), *Endangered Species Act - Section 7 Consultation, Biological Opinion* issued March 2, 1995, requires the U.S. Army Corps of Engineers to develop an emergency auxiliary water supply system for all adult fishways where determined to be necessary in coordination with NMFS. A reconnaissance level technical report [*Lower Snake River, Adult Ladder Systems, Emergency Auxiliary Water Supply* (Phase I - Technical Report)] prepared in 1995 identified several alternative methods of providing emergency auxiliary water supply for each of the adult fishway systems at each of the four lower Snake River locks and dams to address the Biological Opinion requirement. This Emergency Auxiliary Water Supply, Phase II - Technical Report (Phase II - Technical Report) continues to evaluate the Phase I - Technical Report recommended alternatives for the Ice Harbor and Lower Monumental Locks and Dams (Ice Harbor and Lower Monumental) at a greater level of detail. A separate report will further evaluate the Phase I - Technical Report recommended alternatives for Little Goose and Lower Granite Locks and Dams.

An independent technical review was performed on this Phase II - Technical Report at the 60 percent level of completion. The quality control plan for the technical review is included in appendix A. The technical review comments and the responses to them are included in appendix B.

1.02. AUTHORIZATION.

This study is an element of the Columbia River Fish Mitigation Program (CRFMP) and is being conducted under the *Rivers and Harbors Act* of 1945, Public Law 79-14, dated March 2, 1945.

1.03. PURPOSE.

Adult fishway auxiliary water supply systems provide fish attraction water flows to help migrating adult salmonids to find fish ladder entrances and to proceed up the fishways with minimum delay. The focus of this Phase II - Technical Report is the reliability of these auxiliary water supply systems at two of the four lower Snake River locks and dams.

1.04. <u>SCOPE</u>.

The objectives of this Phase II - Technical Report are to evaluate, in greater detail, the alternatives previously identified in the Phase I -Technical Report and recommend a selected alternative for providing emergency auxiliary water supplies for each of the adult fishway systems at Ice Harbor and Lower Monumental. This Phase II - Technical Report identifies a construction cost estimate including engineering and design (E&D) and supervision and administrative (S&A) costs and presents a proposed schedule for completing the design and construction of the recommended alternatives for each dam. Appendix C contains the total project cost summaries for the alternatives recommended in this Phase II - Technical Report.

1.05. <u>PRIOR STUDIES AND REPORTS</u>.

Several studies and reports already completed as well as new investigations were used to help prepare this Phase II - Technical Report (appendix G). The following is the listing of the prior studies and reports:

- *Lower Snake River, Adult Ladder Systems, Emergency Auxiliary Water Supply*, November 1, 1995, (Phase I - Technical Report)

- *Hydraulic Evaluation of Adult Fish Passage Facilities at Ice Harbor Dam*, December 1995

- *Columbia River Salmon Mitigation Analysis System Configuration Study Phase I*, April 1994

- *Hydraulic Evaluation of Adult Fish Passage Facilities at Little Goose, Lower Monumental, and McNary (South Shore) Dams*, November 1988.

1.06. <u>PHASE I - TECHNICAL REPORT RECOMMENDATIONS SUMMARY</u>.

The Phase I - Technical Report discussed three basic types of alternatives for improving the reliability of the existing auxiliary water supply and for providing additional emergency auxiliary water. The following are the three basic types of alternatives discussed:

- Modify the existing pump system to improve reliability or add additional pumps.

- Develop new sources of gravity water supply.

- No action.

Several specific examples of these basic types of alternatives were evaluated for Ice Harbor and Lower Monumental, and the alternatives recommended for further investigation in this Phase II - Technical Report were as follows:

a. Ice Harbor - North Shore.

(1) Add two 7.08 cubic meters per second (cms) [250 cubic feet per second (cfs)] pumps south of navigation lock and improve electrical redundancy.

(2) Add a gravity supply system through the north nonoverflow section to supply 14 cms (500 cfs).

(3) Add two 9.91 cms (350 cfs) barge mounted pumps shared with Lower Monumental.

b. Ice Harbor - South Shore.

(1) Improve reliability and upgrade electrical.

(2) Enhance preventive maintenance program.

c. Lower Monumental.

(1) Add a gravity supply system through the south nonoverflow section to supply 19.8 cms (700 cfs).

(2) Add two 9.91 cms (350 cfs) pumps on north shore.

(3) Enhance preventive maintenance program.

(4) Add two 9.91 cms (350 cfs) barge mounted pumps shared with Ice Harbor.

1.07. ASSESSMENT CRITERIA.

Providing spare water supply capacity increases system reliability by providing emergency water supply for use during partial failures. It also increases the opportunity for practicing preventative maintenance on idle equipment without requiring system operation outside the criteria of the *Fish Passage Plan* (FPP), U.S. Army Corps of Engineers, March 1998, during the maintenance activity. Actual operating time on equipment can be reduced, thus increasing useful operating life. The following general criteria were used in Phase I and Phase II - Technical Reports for assessing existing systems, sizing gravity supply systems, sizing additional pumping alternatives, and providing improved reliability:

a. Mechanical Reliability.

The mechanical pumping system's reliability should provide approximately one pump equivalent of additional capacity above the maximum required in the FPP. In the event of a single pump outage, the system will be able to stay within the FPP criteria. Operation with only one ladder system is not considered an acceptable mode of operation in this Phase II - Technical Report. Proposed improvements allow operation to continue with a single failure in one fish ladder system at any one time. It is assumed that repairs would be made efficiently, and that systems would be returned to optimum condition expeditiously.

Performing expeditious repairs and efficient, cost effective routine maintenance requires that certain mission essential support equipment be available on short notice. Therefore, this Phase II - Technical Report discusses providing additional on-site cranes and hoists where appropriate.

b. Electrical Reliability.

Ideally, the electrical reliability should provide for 100 percent backup in the event of electrical outage due to bus, switchgear, or transformer failures. For some features (*e.g.,* station service transformers, main feeders, and switchgear), this redundancy was provided in the original design. Where historical data shows that failures have been rare or have never occurred in key components, changes in the electrical arrangement (required for full 100 percent backup of those components) are not economically justified. However, where aging equipment justifies it or where current technology has improved, changes in equipment to increase system reliability are proposed. Also, a logical division of electrical service is proposed to provide for at least partial water supply during the repair period following any motor controller electrical failure.

1.08. SUMMARY OF ADULT FISH PASSAGE HYDRAULIC CRITERIA.

a. History.

In 1969 from July through September, Burton Carnegie and Charles Junge conducted operational fishway studies at The Dalles Lock and Dam. They found that the largest percentage of the adult salmonids passed through the entrance with a weir depth of 2.4 meters (m) [8.0 feet (ft)] in the north fishway. When the weir depth was 1.2, 1.8, and 2.3 m (4, 6, and 7.5 ft), the percentage of adult salmonids that passed through the entrance over the weir decreased. Additional experimentation was initiated at Ice Harbor in September 1969 to test the advisability of increasing the auxiliary water supply used to obtain a head of at least 0.3 m (1 ft) and a weir depth of 2.4 m (8 ft). The results from that experiment indicated that the preferred depth for both ladder entrances was also 2.4 m (8 ft). Studies in the 1970's further indicated that salmonids prefer a depth of 2.4 m (8 ft) or greater in the fishways.

b. Current Criteria.

In 1980, the criteria for the Snake River locks and dams were changed to the new criteria resulting from the studies noted in paragraph 1.08.a. The new criteria were included in the FPP (a document that describes year-round project operations necessary to protect and enhance salmon species as well as other anadromous fish species). The FPP is revised periodically to incorporate changes to project operation and maintenance (O&M) as a result of new facilities or changes in operational procedures developed through coordination with other agencies. Fish biologists believe that dam passage delays for migrating salmon would be reduced if fishways are operated within the new optimum criteria in the FPP. The 1998 FPP criteria for the operation of adult fishways for Ice Harbor and Lower Monumental are listed below:

(1) Ice Harbor:

(a) North Shore Entrance (NSE), North Powerhouse Entrances (NPE 1 and 2), and South Shore Entrance (SSE).

The weir depth will be maintained at 2.4 m (8 ft) or greater below tailwater elevation. At low flow/tailwater only 1.8 m (6 ft) of depth may be possible. When the tailwater elevation is less than 103.71 m (340.25 ft), then the weir will be on sill [elevation of the top of the weir gate on sill = 101.26 m (332.23 ft)].

(b) Head on All Entrances.

All entrances will be maintained at 0.3 to 0.6 m (1 to 2 ft) head.

(2) Lower Monumental:

(a) North Shore Entrances (NSE) 1 and 2.

A weir depth will be maintained at 2.4 m (8 ft) or greater below tailwater elevation. When the tailwater elevation is less than 133.2 m (437.0 ft), then the weir will be on sill [elevation of the top of the weir gate on sill = 130.8 m (429.0 ft)].

(b) South Powerhouse Entrances (SPE) 1 and 2.

A weir depth will be maintained at 2.4 m (8 ft) or greater below tailwater elevation. When the tailwater elevation is less than 134.1 m (440.0 ft), then the weir will be on sill [elevation of the top of the weir gate on sill = 131.7 m (432.0 ft)].

(c) South Shore Entrance (SSE) 1.

A weir depth will be maintained at 2.4 m (8 ft) or greater below tailwater elevation. When the tailwater elevation is less than 133.8 m (439.0 ft), then the weir will be on sill [elevation of the top of the weir gate on sill = 131.4 m (431.0 ft)].

(d) South Shore Entrance (SSE) 2.

Gate (lift gate operated as sluice gate) should be raised 1.83 m (6 ft) above sill [elevation of the sill = 131.4 m (431.0 ft)].

SECTION 2 - ICE HARBOR

2.01. GENERAL.

Ice Harbor is the first dam above the mouth of the Snake River, located at river kilometer 15.61 (mile 9.7). The normal range of forebay pool elevations is 133.2 to 134.1 m (437 to 440 ft) mean sea level (msl). The tailwater elevation typically varies between 102.9 to 106.7 m (337.5 to 350 ft). The adult fishway systems are intended to provide safe and efficient passage past the dam for upstream migrating salmonids. Two separate adult fishway systems make up these facilities, one on the north shore and one on the south shore. Both systems include a fish ladder, a collection system, and an auxiliary water supply system (plate 2).

2.02. NORTH SHORE ADULT FISHWAY SYSTEM DESCRIPTION.

a. Auxiliary Water Supply System.

The north shore auxiliary water supply system is composed of three motor driven pumps, a large conduit, and nine diffusers (plate 3). Gravity flow down the ladder from the forebay does not provide enough auxiliary attraction water at the entrances; an auxiliary water supply system supplies the balance of the required attraction water.

Three vertical propeller pumps driven by electric motors are located near the downstream end of the navigation lock to provide the auxiliary attraction water. Each pump is rated at 7.08 cms (250 cfs) at 1.07 m (3.5 ft) of head (pool to pool). The pumps discharge into an open discharge channel from which a 4.88 m (16 ft) wide by 3.05 m (10 ft) high rectangular conduit carries the water to the diffusers.

Pump motors are fed directly from breakers (used for starting "across the line") mounted parallel on a single, three-phase, medium-voltage bus, FSP2. Parallel to the pump motor breakers is a single breaker feeding a transformer and low-voltage bus (FSQ2) that feeds controls, annunciations, and other loads associated with the auxiliary water supply pumps (plate 4). The FSP2 bus can be fed from either of two redundant station service feeders, which in turn can be fed from redundant station service buses with redundant sources.

There are eight diffusers in the fish ladder between weirs 338 and 353 (diffusers 2 through 9), and one large diffuser (diffuser 1) just upstream from the main entrances. Overflow weirs and orifices in the diffuser wells control where and how much water enters the ladder diffusers. The weir crests are set so that more diffusers come into operation as the tailwater elevation rises. The purpose of these diffusers is to add enough water to the ladder to maintain a minimum transportation velocity of 0.457 meters per second (mps) [1.5 feet per second (fps)] over the fish ladder weirs as

they are submerged by the tailwater. All of the diffusers were sized so the upward velocity is no more than 0.076 mps (0.25 fps) over the gross area of the diffuser.

b. Fish Ladder.

The north shore fish ladder is 4.88 m (16 ft) wide and has a floor slope of 1 vertical to 10 horizontal. A control section at the top of the ladder regulates the flow down the ladder at about 2.10 cms (74 cfs) for varying forebay pool elevations.

c. Fishway Collection System.

Two of the three main entrances on the north shore (NSE-1 and NSE-2) face downstream near the downstream end of the spillway stilling basin. These entrances are 3.66 m (12 ft) wide overflow weirs that are 7.62 m (25 ft) tall fully extended. The sill elevation is at 101.2 m (332.0 ft) and the minimum weir crest elevation is at 101.3 m (332.25 ft). The third entrance (NSE-3) opens onto the side of the stilling basin. This entrance is also equipped with a 3.66-m-wide (12-ft-wide) weir gate. Normally, only NSE-1 is operating and NSE-2 and NSE-3 are closed (plate 3).

d. Original Operating Criteria.

The auxiliary water supply system was originally designed to maintain a velocity at the fishway entrance of 1.22 mps (4 fps), by providing about 76 millimeters (mm) (0.25 ft) of head differential across the entrance weirs. It also maintained the minimum transportation velocity over the lower weirs in the fish ladder at varying tailwater elevations, as described in the preceding paragraph. The system was designed to provide good fish passage conditions for tailwater elevations between 102.3 and 108.5 m (337.5 and 356 ft). Entrance weir submergence varied from 1.04 m (3.4 ft) at low tailwaters to nearly 3.05 m (10 ft) at very high tailwaters. This flexibility in entrance weir submergence was provided because as tailwater increased, more auxiliary water supply was required to maintain adequate transportation velocities over submerged fish ladder weirs. Total discharge also varied. Only one pump was required at very low tailwaters. Additional pumps were turned on as the tailwater got higher and more diffusers began to pass water.

e. Current Operating Criteria.

As described in the paragraph 1.08., the current operating criteria for the entrance weirs specify that the weir crests should be at least 2.44 m (8 ft) below the tailwater elevation with a head differential between the channel and tailwater of 305 to 610 mm (1 to 2 ft). These criteria apply at all times during the adult fish passage period (March 1 through December 31) except when tailwater is below 103.71 m (340.25 ft) where the weirs are on sill (FPP).

2.03. EVALUATION OF THE EXISTING NORTH SHORE AUXILIARY WATER SUPPLY SYSTEM.

a. Pump Capacity Limitations.

As described above, the current weir depth and head differential based operating criteria of the FPP requires greater pump discharge at given heads in most conditions than the original flow-based design criteria. This change in operating criteria places greater demand upon the existing auxiliary water supply system. As described above, diffusers were designed to maintain a minimum transportation velocity over the fish ladder weirs as they become submerged by the tailwater. As tailwater elevation drops, fewer diffusers come into operation. With the new criteria, this results in higher pumped head because more water is being forced through fewer diffusers. Higher pumped head results in less pump discharge. All three pumps must operate continuously to attempt to satisfy the FPP. No backup water supply is available should one of the auxiliary water supply pumps require maintenance and the system must operate out-of-criteria during the maintenance period.

b. Mechanical Reliability.

The pumps and speed reducers are over 35 years old and are at the end of what is normally considered the useful operating life for this type of equipment. The motors are of heavy-duty construction and appear to be in good, smooth-running condition. They are estimated to have a remaining life span of about 25 years with good maintenance. One of the speed reducers has had a bearing replaced and the bottom bushing in pump 2 was replaced when the pump was rebuilt. Ice Harbor does not have a complete set of spare parts for the pump system.

The three pumps discharge into a common channel with a bulkhead arrangement that prevents pump isolation in some situations. Depending on which pump fails, it may be necessary to shutdown all pumps to make repairs.

The north shore auxiliary water supply system was constructed without provisions for handling the pumps, motors, or isolation bulkheads during maintenance or replacement. In order to perform maintenance requiring a crane, two cranes must be rented and mobilized. A large crane [minimum rating: 127 000 kilograms (kg) (140 ton)] must be obtained for the purpose of lowering a smaller rented crane from the navigation lock deck to the pump deck. The smaller crane [minimum rating: 59 000 kg (65 ton)] must be partially disassembled, lowered, and then reassembled before it can be used. The larger crane may then remain in standby status, as dictated by repair requirements, schedule, and cost considerations. This entire procedure is dependent upon crane availability and is potentially hazardous, labor intensive, and expensive.

The fishway entrances do not have lifting and handling equipment that can be used to raise the gates and bulkheads out of their slots for maintenance or repositioning.

c. Electrical Reliability.

The electrical system configuration presents some additional, potential problems. The single, three-phase, medium-voltage bus (FSP2) is a vulnerable point in the electrical system. A destructive fault in FSP2 could disable all three pumps for an extended period of time. There is neither alternate electrical bus nor switchgear through which power could be routed to the pump motors.

The starting of motors "across the line" using breakers has proven to be a reliable method, because motors start infrequent. The principle limitation of using power circuit breakers for motor-starting duty is the degree of repetitive duty that breakers can withstand. The continued use of these breakers for motor-starting duty makes a failure more likely. Since the breakers are operated locally, there is also a risk of serious injury in the event of a major destructive fault.

2.04. NORTH SHORE AUXILIARY WATER SUPPLY SYSTEM IMPROVEMENT ALTERNATIVES.

a. Alternative 1 (Criteria Revision with No Water Supply Additions, Upgrade Electrical, and Improve Systems).

This alternative was not discussed in the Phase I - Technical Report but is presented here as a lower cost alternative to adding backup equipment. It proposes to make a criteria revision combined with a series of improvements to features of the adult fishway auxiliary water supply system to improve hydraulics and enhance reliability. A discussion of the system hydraulics relating to a criteria revision and a list of several concurrent improvements are presented below.

(1) Hydraulic Discussion.

As noted in the paragraph 2.03.a., all three pumps must run continuously to attempt to satisfy the FPP. The following discussion explains why and how a criteria revision would ensure that existing pumps could provide a "one pump equivalent" emergency water supply.

(a) Effect of Current Operating Criteria on Pump Discharge.

At low tailwater elevations (when the entrance weir crest is at or near the sill), the coefficient of discharge is larger than when the weir crest is higher relative to the sill. This means that for the same submergence and head differential, more water passes over the weir at low tailwater elevations. At the same time, the least

amount of total effective diffuser area is available at low tailwaters because most of the ladder diffusers are not operating.

The head differential between the tailwater and the energy grade line in the water supply conduit must be higher to drive the same amount of water through the smaller number of operating diffusers. The system was designed for a pumped head of about 1.07 m (3.5 ft). Operating with the current criteria, the pumped head is 1.37 to 1.68 m (4.5 to 5.5 ft), therefore, the pumps produce less than their rated design discharge.

(b) Effect of Revised Operating Criteria on Pump Discharge.

Alternative 1 proposes a hydraulic operating criteria that allows more flexibility in the required entrance weir submergence, relying more on head differential- and discharge-based criteria. At high tailwater elevations (where the most auxiliary water supply should be necessary to provide adequate transportation velocities over submerged fish ladder weirs), the standard entrance weir configuration with 2.44 m (8 ft) of submergence and 305 mm (1 ft) of head differential requires a discharge of about 15.3 cms (540 cfs). Assume that this discharge should be approximately the minimum discharge necessary. [Weir discharges referred to in the text and tables 2-1 and 2-3 of this Phase II - Technical Report are calculated based on equations and coefficients developed in a model study (*Technical Report 109-1, Fish Ladders for Lower Monumental Dam, Snake River, Washington*, Corps of Engineers, December 1973).]

Table 2-1 shows the submergence required at various tailwater elevations with 305 mm (1 ft) of head differential to produce approximately this minimum discharge of 15.3 cms (540 cfs) over the weirs. The total discharge is the sum of the discharge produced by the auxiliary water supply pumps plus the design gravity flow down the fish ladder from the forebay of 2.10 cms (74 cfs). The float control at diffuser 10 would be adjusted to increase the head over the first overflow weir by about 61 mm (0.2 ft), as recommended from the *Hydraulic Evaluation of Adult Fish Passage Facilities at Ice Harbor Dam*, December 1995. This would increase flow down the fish ladder by about 0.283 cms (10 cfs), bringing it up to the design flow of 2.10 cms (74 cfs). The table shows that at tailwater elevations at or below 103 m (338 ft), the weir will be bottomed out on the sill and the head differential across the weir must be greater than 305 mm (1 ft) to maintain the minimum required discharge.

Table 2-2 shows the pump discharges associated with varying heads for the existing pumps. According to table 2-1, the minimum required pump discharge is about 13.3 cms (470 cfs). Table 2-2 shows that two pumps can supply this demand at 1.22 m (4 ft) of head. Tests conducted with two pumps operating as part of a previous hydraulic evaluation had a pumped head of 1.25 m (4.1 ft), weir submergence of 2.13 m (7 ft), and head differential across the weir of 335 mm (1.1 ft), confirming the numbers at the test configuration. Thus, operating with this revised

criteria allows operation with two pumps running without increasing the capacity of the existing pumps, thus providing one pump for emergency backup.

Table 2-1: Required Pump Discharge with Varying Submergence

Tailwater		Submergence		Weir Discharge		Pump Discharge		Entrance Weir Head	
m	ft	m	ft	cms	cfs	cms	cfs	mm	ft
102.9	337.5	1.60	5.25	15.60	551	13.51	477	396.2	1.3
103.0	338	1.75	5.75	15.86	560	13.76	486	335.3	1.1
103.3	339	1.92	6.3	15.60	551	13.51	477	304.8	1.0
103.6	340	2.01	6.6	15.46	546	13.37	472	304.8	1.0
103.9	341	2.10	6.9	15.60	551	13.51	477	304.8	1.0
104.2	342	2.16	7.1	15.52	548	13.42	474	304.8	1.0
104.5	343	2.23	7.3	15.57	550	13.48	476	304.8	1.0
104.9	344	2.29	7.5	15.66	553	13.56	479	304.8	1.0
105.2	345	2.32	7.6	15.60	551	13.51	477	304.8	1.0
105.5	346	2.35	7.7	15.55	549	13.45	475	304.8	1.0
105.8	347	2.38	7.8	15.55	549	13.45	475	304.8	1.0
106.1	348	2.41	7.9	15.57	550	13.48	476	304.8	1.0
106.4	349	2.44	8.0	15.60	551	13.51	477	304.8	1.0
106.7	350	2.44	8.0	15.46	546	13.37	472	304.8	1.0
107.0	351	2.44	8.0	15.40	544	13.31	470	304.8	1.0
107.3	352	2.44	8.0	15.38	543	13.28	469	304.8	1.0

Table 2-2: Existing Pump Discharges (based on manufacturer's pump curves)

Pump Head		1 Pump Discharge		2 Pump Discharge		3 Pump Discharge	
m	ft	cms	cfs	cms	cfs	cms	cfs
0.914	3.0	7.70	272	15.40	544	23.10	816
1.07	3.5	7.28	257	14.55	514	21.83	771
1.22	4.0	6.79	240	13.59	480	20.39	720
1.37	4.5	6.29	222	12.57	444	18.86	666
1.52	5.0	5.66	200	11.33	400	16.99	600
1.68	5.5	4.76	168	9.51	336	14.27	504

(2) <u>Electrical Upgrade and Redundancy</u>.

Replacement of the existing water supply pump breaker in the FSP2 switchgear with a new split bus arrangement of switchgear would provide improved electrical redundancy. See the "North Ladder Fishpump One-line Revision" on plate 4. In addition, it would allow replacement of existing medium-voltage breakers, being used

to start motors, with medium-voltage starters. Electronic "soft-start" controllers could be used provided the advantages justify the extra costs. As indicated on plate 4, the switchgear would be configured to place one starter in an isolated intermediate section, which could be fed from either half of the switchgear bus. Each of the other two pumps would be fed from medium-voltage starters as well, one in each half of the split bus switchgear. Starters are designed for more operations and longer life under severe operating duty cycles than are power circuit breakers.

A tie breaker would be provided between the halves of the split bus giving Project Operations flexibility in the mode of operation. The tie breaker could be either closed, allowing feed from either of the existing redundant station service feeders to all three pumps and low-voltage loads, or it could be open, allowing feed from both feeders concurrently to respective portions of the split bus. In the event of a fault in either portion of the split bus switchgear, two pumps would still be operable. Failure of the half of the split bus feeding the low-voltage system, FSQ2, could be overcome by back-feeding FSQ2 over existing feeders from LSQ1, located in the navlock operations building. A limiting factor which must be investigated during design, and which may affect installation cost, is physical space availability for new switchgear. The existing portion of the medium-voltage switchgear that would be replaced is smaller than the new switchgear proposed above. This may require new switchgear to be located outdoors. The cost estimate is based on that assumption.

These electrical system upgrades would require the associated water supply pumping system to be shutdown for approximately 2 to 3 months. This period could be used to accomplish any of the major mechanical or structural upgrades discussed below as well. The work would be scheduled during a slow adult fish migration period and the south shore system would remain operational during the north shore work.

(3) Rebuild Pumps and Appurtenances.

Project Operations would include in their O&M budget planning process provisions to rebuild the existing 7.08 cms (250 cfs) pumps. Critical appurtenances (*e.g.*, the hydraulic system that operates the butterfly valves on the pump discharges, entrance weirs, and staff gauges) would also be rebuilt through the O&M process.

(4) Bulkheads.

The existing system of bulkheads for isolating the auxiliary water supply pumps does not allow each of the pumps to be isolated for maintenance or repairs without affecting the operation of the other two pumps. To improve the redundancy of the system, two new bulkheads would be added in the discharge channel (plate 5). The guides for the bulkheads would be fabricated from stainless steel and anchored to the concrete wall using adhesive anchors. The bulkheads would

be constructed of structural steel and painted and would be either stored on the deck until they were needed, or dogged off in the top of the guides.

(5) Diffuser Modifications.

Current operating submergence criteria requires that at low and intermediate tailwater elevations [up to about 106.4 m (349 ft)], more water must pass through fewer diffusers. The head differential between the tailwater and the collection channel must be higher than the original design condition to allow this to happen.

The five passages between the supply conduit and number 1 diffuser well would be enlarged to reduce the head differential requirement. The diffusers were originally designed for a maximum vertical velocity of 0.076 mps (0.25 fps) over the gross area of the diffuser. Current diffuser design criteria allow for higher velocities, up to 0.152 mps (0.5 fps).

Each of the five diffuser openings is 914.4 mm (3 ft) square, for a total open area of 4.2 square m (45 square ft). The openings would be enlarged to 1.2 m (4 ft) square, to give 7.2 square m (80 square ft) of total open area. Additional reinforcement would be added at the expanded openings. This would reduce the required head by 153 to 305 mm (0.5 to 1.0 ft) (plate 6).

(6) Auxiliary Water Supply Pump Crane and Fishway Entrance Hoist.

Modifications to improve reliability for the north shore auxiliary water supply system would include installing a permanent crane in the vicinity of the auxiliary water supply pumps. The crane would be capable of safely handling the pumps, motors, and associated components; lifting them to the required heights; and positioning them where they could be worked on effectively. Isolation bulkheads could also be placed or removed. A previous investigation proposed adding a stiff leg derrick, whirly type crane; a selection based on cost and flexibility (plate 18).

Also included would be a hoist at the fishway entrance location to allow handling bulkheads and weirs on short notice.

(7) Spare Parts and Enhanced Maintenance.

This section of the alternative was evaluated in the Phase I - Technical Report, but was not included in the final recommendation. However, further review concluded that an enhanced maintenance program and an increased on-hand inventory of spare parts would substantially increase the reliability of the adult fish passage system if combined with the above-mentioned improvements. Therefore, Project Operations would incorporate in their O&M funding plans provisions for enhanced preventative maintenance and additional spare parts. An example of spare

parts that could be included are listed in table 2-3. Appendix H contains a list of O&M backlog work items.

Table 2-3: Typical Spare Parts for Ice Harbor Adult Fishway System

Number	Item
1	Butterfly valve pivots
2	Dewatering/sump pumps
3	Differential sensing unit
4	Brass tees
5	Hose bibbs
6	Gate valves
7	Reducers
8	Mud valves
9	Valve extension stems
10	Valve handwheels
11	Stuffing boxes for dewatering/sump pumps
12	Hydraulic pump for butterfly valve operator
13	Accumulators
14	Check valve
15	Pressure switch
16	Drain valve
17	Grease unit
18	Lube block tees
19	Pilot bleed
20	Lube measuring valves
21	Shut-off valves
22	Misc. copper fittings and tubing
23	Misc. hoses
24	Gear set
25	Pump motors
26	Electrical alarms

(8) Conclusion.

The objective of this study is to improve the reliability of the auxiliary water supply system to meet existing FPP criteria. The goal should be to provide the flows required to meet both the submergence and head requirements as stated in the FPP. Because this alternative does not improve Ice Harbor's ability to meet the FPP criteria and results in an actual reduction in the amount of fish attraction water flow leaving the fish entrances, it is not recommended for implementation.

b. Alternative 2 (Upgrade Existing Pumps, Upgrade Electrical, and Improve Systems).

One alternative recommended for further investigation in the Phase I - Technical Report consisted of adding a new concrete intake structure and pumps to provide emergency auxiliary water supply to the north shore adult fishway system. During more detailed analysis of this alternative, it was discovered that it would be necessary to tunnel under the existing auxiliary water supply conduit in order for water to reach the new pump intakes. Therefore, the cost and complexity of adding new pumps in the location proposed in the Phase I - Technical Report was thought to be prohibitive in relation to the costs of other alternatives. Other locations for the new pumps were also ruled out because they either placed the pumps in the spillway stilling basin, or it was not possible to determine a reasonable way to connect the new pump discharges to the existing system.

While investigating the pumping system, it was determined that the three existing pumps could be upgraded. Two upgraded pumps would provide sufficient water supply, allowing one of the three pumps to serve as a backup pump. The pumps could be upgraded without modifying the existing pump intake structure. This method of providing emergency backup capability is further discussed in the following paragraphs. This alternative includes a series of improvements to features of the adult fishway auxiliary water supply system to enhance reliability and improve hydraulics. The various elements of this alternative are presented below.

(1) Upgrade Existing Pumps.

The existing 7.05 cms (250 cfs) pumps would be upgraded to 8.50 cms (300 cfs) by replacing the impeller, bearings, and liner in each. The pump motors and gearboxes would also be replaced, but no change to the intake and discharge structure would be necessary. The new pump motors would have oil-lubricated bearings for a long maintenance-free life. Spare parts would be provided along with the upgraded equipment, as typically furnished with new equipment.

In addition to upgrading the pumps, some critical appurtenances would need to be rebuilt (*e.g.,* the hydraulic system that operates the butterfly valves on the pump discharges, entrance weirs, and staff gauges). Since pump upgrades would affect appurtenances, this work would be included in the pump upgrade work. The cost estimate in appendix D does not include the cost of rebuilding these appurtenances.

Table 2-4 shows how much water passes over the main entrance weir for varying tailwater elevations for a configuration with 2.44 m (8 ft) of submergence and 305 mm (1 ft) of head differential across the weir. Below tailwater elevation 103.7 m (340.25 ft), the weir is bottomed out on the sill and the submergence is less than 2.44 m (8 ft). The weir discharge is the combined pumped auxiliary water supply discharge and the 2.10 cms (74 cfs) gravity flow down the fish ladder.

Table 2-5 shows the pump discharges for the proposed upgrade to 8.50 cms (300 cfs) pumps to replace the existing 7.05 cms (250 cfs) pumps. Comparing the required pump discharges from table 2-4 to the data in table 2-5, shows that two pumps would be able to satisfy the required pump discharges at a head of 1.22 to 1.37 m (4 to 4.5 ft). This would be true for all tailwater elevations except a narrow range when the weir first bottoms out . The system would operate at about this head or less if the diffusers were modified as described in paragraph 2.04.a.(5). The actual effect of the diffuser modifications on pump capacity would be analyzed during plans and specifications to help determine the actual pump capacity needed. The analysis is expected to show that the upgraded pumps and modified diffusers would allow the system to meet criteria more often than if either is done alone.

Table 2-4: System Discharges for Current Operating Criteria

Tailwater		Submergence		Weir Discharge		Pump Discharge	
m	ft	m	ft	cms	cfs	cms	cfs
102.9	337.5	1.60	5.25	13.73	485	11.61	411
103.0	338	1.75	5.75	15.15	535	13.02	461
103.3	339	2.06	6.75	17.92	633	15.80	559
103.6	340	2.36	7.75	20.73	732	18.60	658
103.7	340.25	2.44	8.0	21.44	757	19.31	683
103.9	341	2.44	8.0	19.71	696	17.58	622
104.2	342	2.44	8.0	18.49	653	16.37	579
104.5	343	2.44	8.0	17.67	624	15.55	550
104.9	344	2.44	8.0	17.08	603	14.95	529
105.2	345	2.44	8.0	16.65	588	14.53	514
105.5	346	2.44	8.0	16.31	576	14.19	502
105.8	347	2.44	8.0	16.06	567	13.93	493
106.1	348	2.44	8.0	15.83	559	13.71	485
106.4	349	2.44	8.0	15.60	551	13.48	477
106.7	350	2.44	8.0	15.46	546	13.34	472
107.0	351	2.44	8.0	15.40	544	13.28	470
107.3	352	2.44	8.0	15.38	543	13.25	469

Table 2-5: Proposed Upgraded Pump Discharges (based on manufacturer's pump curves)

Pump Head		1 Pump Discharge		2 Pump Discharge		3 Pump Discharge	
m	ft	cms	cfs	cms	cfs	cms	cfs
0.914	3.0	9.51	336	19.03	672	28.54	1008
1.07	3.5	9.21	325	18.41	650	27.61	975
1.22	4.0	8.86	313	17.73	626	26.59	939
1.37	4.5	8.50	300	16.99	600	25.49	900
1.52	5.0	8.07	285	16.14	570	24.21	855
1.68	5.5	7.65	270	15.29	540	22.94	810

(2) Electrical Upgrade and Redundancy.

The pump upgrade described above would require replacement of the three existing 149 kW [200 horsepower (hp)], 4160-volt (V) pump drive motors with 224 kW (300 hp) motors. The existing 4160-V distribution feeders (redundant feeders from the station service bus in the powerhouse) are adequately sized to supply the larger motor loads and would therefore not need to be replaced. However the following electrical system modifications would be required.

Three existing medium-voltage breakers used for starting pump motors "across the line" would be replaced with three, medium-voltage starters sized for the larger 224 kW (300 hp) motors. Soft-start type electronic starters with bypass contactors could be used if determined during design that the advantages justify the additional costs. Existing pump motor feeder wire and conduit between the starters and the motors would be replaced. The new starters would be installed in switchgear configured as described in paragraph 2.04.a.(2), thereby providing electrical distribution redundancy. This new configuration allows operation of two pumps with a single bus failure. Annunciation systems would be upgraded concurrent with the switchgear upgrades with redundant alarm indication added in the powerhouse control room.

These electrical system upgrades would require the associated water supply pumping system to be shutdown for approximately 2 to 3 months. This period could be used to accomplish any major mechanical equipment maintenance on the system as well. The work would be scheduled during a slow adult fish migration period and the south shore system would remain operational during the north shore work.

(3) Bulkheads.

As mentioned in paragraph 2.04.a.(4), the addition of bulkheads to isolate the pumps would be necessary for this alternative. The information is identical

to the above paragraph. The installation of the bulkheads would facilitate the pump upgrade process.

(4) Diffuser Modifications.

See paragraph 2.04.a.(5), for modifications to improve the flow conditions into fish ladder diffuser 1. These modifications would allow the upgraded pumps to produce more flow because of the reduced pump head requirements.

(5) Auxiliary Water Supply Pump Crane and Fishway Entrance Hoist.

As discussed in paragraph 2.04.a.(6), modifications to improve reliability would include installing a permanent crane in the vicinity of the auxiliary water supply pumps and a hoist at the fishway entrance location. The installation of the crane would facilitate the pump upgrade process.

(6) Spare Parts and Enhanced Maintenance.

Project Operations would incorporate in their O&M funding plans provisions for enhanced preventative maintenance and additional spare parts as discussed in paragraph 2.04.a.(7).

(7) Conclusion.

This alternative would provide a backup water source with minimal disruption and no increase in maintenance. Alternative 2 is recommended for implementation.

c. Alternative 3 (Add Gravity Supply, Upgrade Electrical, and Improve Systems).

This alternative was recommended for further investigation in the Phase I - Technical Report. This alternative consists of a gravity supply system to provide an additional 14 cms (500 cfs) of emergency water. This system would be located at the north nonoverflow section.

(1) Description.

This alternative would provide 14 cms (500 cfs) of additional auxiliary water supply by gravity flow, resulting in spare flow equal to two pumps to provide emergency backup of existing pumps and meet the FPP. At least one of the existing auxiliary water supply pumps would need to be operated concurrent with the gravity supply system to provide enough water under all operating conditions. Three different screened reservoir water intake systems mounted to the upstream face of the dam were considered and are described below as part of the gravity supply system. The gravity

supply system would include an 1 800-mm-diameter [72-inch (in)-diameter] supply pipe through the north nonoverflow section of the dam. The supply pipe would be cement mortar lined and painted steel pipe. Two different north shore fish ladder supply conduit connections were considered and are also described below as part of the gravity supply system.

(2) Reservoir Water Intake System.

One of the reservoir water intake systems would use cylindrical tee screen assemblies and the other two would use flat screens. The screens would be manufactured from stainless steel wedge wire and would be sized based on 2-mm-wide (0.079-in-wide) slots with 0.12 mps (0.4 fps) approach velocity and 50 percent open area. Trashracks would not be installed in front of any of the reservoir water intake screen systems. The screens would be submerged at all times and would not be subject to damage by floating debris. The water current in the vicinity of the screens would not be very high and would not subject the screens to impact by submerged debris. Similar intake screen systems are commonly installed in rivers without trashracks. Also, trashracks would themselves require some sort of cleaning system. Warning signs would be posted directing surface vessels to stay clear of the submerged intake screens.

All intake system options would have an 1 800-mm-diameter (72-in-diameter) supply pipe penetrating the mass concrete of the north nonoverflow section of the dam. The supply pipe through the dam would be positioned to provide a minimum of 1.8 m (6 ft) of submergence with minimum water elevation. An isolation bulkhead would be installed on the upstream end of the supply pipe (plate 10). A bypass around the bulkhead would be provided to allow supply pipe water-up.

All intake system options would use a caisson during supply pipe and isolation bulkhead installation. A permanent caisson would be used with the cylindrical intake screen system (plate 9). A temporary caisson would be used with the flat intake screen systems. The caisson would be anchored to the face of the dam and dewatered using temporary pumps during supply pipe installation. The caisson would have an opening in the top for access. The caisson would be fabricated of structural steel and painted with a submersible coating. The temporary caisson would be similar to the permanent caisson except it would be about 1.52 m (5 ft) shorter and would not have openings for connecting tee screens or supply header pipes. After supply pipe and isolation bulkhead installation, the permanent caisson would be allowed to fill with water and left in place and the temporary caisson would be allowed to fill with water and be removed.

(a) Cylindrical Intake Screen System.

The cylindrical intake screen system would consist of six cylindrical tee screen assemblies connected to a permanent caisson mounted to the

upstream face of the dam. Installation guides would be provided to allow the tee screens to be removed and installed. Divers would be used to observe the installation of the tee screen assemblies to ensure correct alignment during maintenance activities. The use of the tee screens would minimize the number of moving underwater parts requiring maintenance (plates 7, 8, 9, and 11). The estimate in appendix D is based on this type of system.

Each tee screen assembly would be 2.13 m (7 ft) in diameter and 7.01 m (23 ft) long and would be oriented vertically. They would be positioned to provide a minimum of one screen diameter between adjacent screens and submerged enough to provide a minimum of one screen diameter of water depth with the reservoir at minimum water elevation. The tee screen assemblies would be designed to withstand at least 1.52 m (5 ft) of head differential. Crane access to the screens would be by mobile project crane from the deck of the dam.

The tee screens would be provided with an automatic air burst backwash cleaning system. If the air burst backwash cleaning system was not able to remove debris well enough, the tee screen assemblies could be removed and manually cleaned. The air burst backwash cleaning system would include an air compressor, compressed air receiver, control valves, connecting piping, and electrical air burst control system. Because there would be minimal cross flow water currents in the intake screen area, debris loosened from the screens during backwashing could again be drawn against the screens in a short time. For the air burst backwash cleaning system to be most effective, it may be necessary to remove the tee screen from service during the backwash event. Isolation gates would be provided between the tee screen assemblies and the supply header pipe. These gates would allow the individual tee screen assemblies to be removed from service without requiring the entire system to be shutdown. Maintenance of the isolation gates would require divers. The isolation gate system would be designed to require a minimal amount of maintenance.

The electrical power for the air burst backwash cleaning system would be fed from the existing navlock operations building low-voltage switchgear, LSQ1. Routing of conductors would be through north nonoverflow service gallery cable trays and conduit installed through core drilled holes to the deck and/or where necessary. Modifications to switchgear and details of routing would be determined during design, but it is anticipated that it would include a 480-V breaker in LSQ1 and 480-V distribution to the nonoverflow deck.

(b) Flat Intake Screen System (Passive).

The flat intake screen system (passive) would consist of 36 flat wedge wire bar screen panels each measuring 1.83 m (6 ft) square supported by an integrated steel support/porosity control structure. The support/porosity control structure would be assembled on shore and moved into position and secured to the face of the dam. It would be positioned to provide a minimum of 1.83 m (6 ft) of

submergence with minimum water elevation. The support/porosity control structure would be painted with a submersible-type coating. It would have guides for screen panel installation and removal. All screen panels in each column of panels would be connected so they could be removed for cleaning and repair. Divers could be used to observe the installation of the screen panels but would not be needed during screen panel removal during maintenance activities. The screen panels and support structure would be designed to withstand 914 mm (3 ft) of head differential. Crane access to the screen panels would be by mobile crane from the deck of the dam. Access would be provided for divers to get behind the screen panels for maintenance and repair. (Plates 14, 15, and 16.)

Flow control valves would be used to balance the flow through the screen panels. Back flush valves would be connected to back flush headers supplied with water from a submersible 112 kW (150 hp) back flush water pump. The back flush valves would be shut and the flow control valves would be open, as necessary, to provide balanced flow during normal operation. During back flushing, the flow control valve on the screen panel to be back flushed would be shut and the back flush valve on the screen panel to be back flushed would be open. Only one panel would be back flushed at a time. Flow control valves and back flush valves would be pneumatically operated knife gate valves suitable for submerged operation. The flat screen panel back flushing system would be automatic. If back flushing was not effective enough in removing debris, a column of screen panels could be removed for manual cleaning. Because there would be minimal cross flow water currents in the intake screen area, debris loosened from the screen during back flushing could again be drawn against the screen in a short time.

The back flush pump would be sized to provide at least twice the flow rate through the flat screen panel as when the flat screen panel was in normal operation. The back flush pump intake screen would be cylindrical and have the same size openings as the flat screen panels. The back flush pump intake screen would be cleaned with an automatic air burst backwash cleaning system. Differential pressure indicators would be provided on both the flat screen panels and the back flush pump intake screen to warn of screen plugging.

The electrical power for the back flush pump would be fed from the existing navlock operations building medium-voltage switchgear, LSP1. Power for the flat screen panel back flush control system, air compressor, and the air burst backwash control system would be fed from the existing low-voltage switchgear, LSQ1, in the navlock operations building. Routing of conductors would be through north nonoverflow service gallery cable trays and conduit installed through core drilled holes to the deck and/or where necessary. Modifications to switchgear and details of routing would be determined during design. It is anticipated that it would include a medium-voltage breaker, 5 kV distribution to nonoverflow deck, and medium-voltage, soft-start controller for the back flush pump. Also included would be low-voltage distribution to

the air compressor and controls. See plate 19 for a one-line diagram of the flat intake screen system.

(c) Sloped Flat Intake Screen System (Active).

The sloped flat intake screen system (active) would also consist of 36 flat wedge wire bar screen panels each measuring 1.83 m (6 ft) square supported by an integrated steel support/porosity control structure. The support/porosity control structure would be assembled on shore and moved into position and secured to the face of the dam. It would be positioned to provide a minimum of 1.83 m (6 ft) of submergence with minimum water elevation. The support/porosity control structure would be painted with a submersible-type coating. It would have guides for screen panel installation and removal. The support/porosity control structure for the active system would be similar in construction to support/porosity control structure for the passive system. The screen panels would be installed at an angle of 10 degrees from the vertical with the top of the screens closer to the face of the dam than the bottom of the screens. All screen panels in each column of panels would be connected so they could be removed for cleaning and repair. Divers could be used to observe the installation of the screen panels, but would not be needed during screen panel removal during maintenance activities. The screen panels and support structure would be designed to withstand 914 mm (3 ft) of head differential. Mobile crane access to the screen panels would be from the deck of the dam. Access would be provided for divers to get behind the screen panels for maintenance and repair (plate 17).

Flow control valves would be used to balance the flow through the screen panels. The flow control valves would be pneumatically operated knife gate valves suitable for submerged operation.

The screen panels would be cleaned by a top-driven screen cleaner system of commercial design (similar to operating screen cleaners in use throughout the country). The screen cleaner system would be in three sections to cover the entire width and length of the screen panels. Each screen cleaner section would consist of a removable frame, pivoting mounting assembly, drive assembly, and drive chain with attached scrapers. The screen cleaner assembly would be removed for maintenance and repair and would not require the use of divers during maintenance activities. The screen cleaner system would continuously and slowly drag scraper bars over the screen panels from bottom to top to scrape off debris. The scraper bars would be held against the screen panels by their own weight and water current. The drive chain would be flexible enough to permit the scraper bars to encounter large debris without damage. Parts of the screen cleaner operating in water would be made of stainless steel or other corrosion-resistant materials. Each screen cleaner section would be driven by a 0.745 kW (1 hp) electric motor. If the screen cleaner system was not effective enough in removing debris, a column of screen panels could be removed for manual cleaning. Differential pressure indicators would be provided to warn of screen plugging.

The electrical power for the screen cleaner system would be fed from the existing navlock operations building low-voltage switchgear, LSQ1. Routing of conductors would be through north nonoverflow service gallery cable trays and conduit installed through core drilled holes to the deck and/or where necessary. Modifications to switchgear and details of routing would be determined during design, but it is anticipated that it would include a 480-V breaker in LSQ1 and 480-V distribution to the nonoverflow deck location, plus starters and control systems. See plate 19 for a one-line diagram of this sloped flat intake screen system.

(3) Supply Conduit Connection.

Two types of supply pipe connections to the north shore fish water supply conduit were considered. One would use a free discharge fixed cone valve and the other an inline sleeve valve to reduce the water pressure supplied to the existing supply conduit.

(a) Free Discharge Cone Valve.

For this option, a fixed cone valve would be mounted on the tailrace deck of the north nonoverflow monolith 2. It would discharge into the area bounded by the navlock on the north, and the fish ladder on the south (stilling area). It would have a fixed hood to concentrate the valve discharge and reduce spray (plates 7 and 8). Fixed cone valves of this type are the recommended industry standard for free discharge applications and for breaking heads of this magnitude [30 m (100 ft)]. The valve discharge would be regulated by an automatic control system based on the difference in water surface elevation in the water supply channel and the tailrace. The valve opening would be set using an electric motor driven actuator. The size of the electric motor is estimated to be 1 kW (1.3 hp) or less. Crane access to the fixed cone valve would be analyzed carefully during preparation of plans and specifications. One possible option would be by mobile crane from the deck of the dam. Another possible option would be to install a new derrick crane on the monolith deck near the fixed cone valve that would be able to reach and lift the equipment.

Two openings would be cut in the north side of the existing north shore fish attraction water supply conduit to allow the water from the new supply pipe into the supply conduit. Wing gates would be installed in the new openings. The wing gates would be rotated so the new openings would be blocked when the existing attraction water supply pumps were operating, and the gravity supply system was not operating. During gravity supply system operation, the wing gates would be rotated to allow water to flow into the supply conduit. The wing gates would not be designed to create a watertight seal. The wing gates would be pneumatically operated and electrically controlled (plates 7, 11, and 12).

The water level in the stilling area would need to be between 914 mm (3 ft) and 1.52 m (5 ft) higher than the water level in the tailrace in order to

provide enough head to maintain adequate fish attraction water flows. The existing equalization holes in the fish ladder training wall would be plugged so the water level in the stilling area could be controlled. The training wall would be reinforced for the added head differential using prestressed rock anchors installed in the wall (plate 13). The water level in the stilling area would be about the same whether the existing attraction water supply pumps or the gravity supply system was in operation. Any debris in the stilling area would be removed prior to operating the gravity supply system.

The electrical power for the cone valve actuator and controls would be fed from the existing navlock operations building low-voltage switchgear, LSQ1. Routing of conductors would be through north nonoverflow service gallery cable trays and conduit installed through core drilled holes to the deck and/or where necessary. A control location would be located on the nonoverflow deck, with power and control circuits routed down the downstream face of the nonoverflow section to the motor and instrumentation components. Modifications to switchgear and details of routing would be determined during design. See plate 19 for one-line diagram indicating distribution to "discharge loads," in each intake screen alternative.

(b) Inline Sleeve Valve.

For this option, an inline sleeve valve would be mounted on top of the existing north shore fish attraction water supply conduit and would discharge into it through a hole cut in the top of the supply conduit. Sleeve valves of this type are the recommended industry standard for breaking heads of this magnitude [30 m (100 ft)] quietly and with a minimum of vibration. The inline sleeve valve installation would not require reinforcing the fish ladder training wall. The valve discharge would be regulated by an automatic control system based on the difference in water surface elevation in the water supply channel and the tailrace. Valve opening would be set using an electric motor driven actuator. The size of the electric motor is estimated to be 1 kW (1.3 hp) or less. Personnel access to the sleeve valve area would be via stairs and walkways supported on the supply pipe (plates 14 and 15). Crane access would be analyzed during preparation of plans and specifications. A possible option would be to provide a monorail and platform below the fish ladder and mount a derrick crane to the top of the fish ladder. The crane could lift equipment from the north side of the fish ladder into a barge moored on the south side of the fish ladder.

The electrical power for actuators and controls would be fed from the existing navlock operations building low-voltage switchgear, LSQ1. Routing of conductors would be through north nonoverflow service gallery cable trays and conduit installed through core drilled holes to the deck and/or where necessary. A control station would be located on the nonoverflow deck, with power and control circuits routed down the downstream face of the nonoverflow section to actuators and instrumentation components. Modifications to switchgear and details of routing would

be determined during design. See electrical plate 19 for one-line diagram indicating "discharge loads," in each intake screen alternative.

(4) Electrical Upgrade and Redundancy.

Because at least one of the existing auxiliary water supply pumps would still be required with this alternative, ensuring reliability would also require some upgrading of the existing pump mechanical and electrical systems. Electrical system upgrade and provision of redundancy similar to that discussed for Alternative 1 in 2.04.a.(2) would be required.

(5) Rebuild Pumps and Appurtenances.

See paragraph 2.04.a.(3) for recommendations regarding Project Operations O&M planning for rebuilding existing components to enhance reliability.

(6) Bulkheads.

As mentioned in paragraph 2.04.a.(4), the addition of bulkheads to isolate the pumps would also be necessary for this alternative.

(7) Diffuser Modifications.

See paragraph 2.04.a.(5) for a description of the modifications to improve the water flow into the fish ladder diffuser 1.

(8) Auxiliary Water Supply Pump Crane and Fishway Entrance Hoist.

As discussed in paragraph 2.04.a.(6), modifications to improve reliability would include installing a permanent crane near the auxiliary water supply pumps and a hoist at the fishway entrances.

(9) Spare Parts and Enhanced Maintenance.

Project Operations would incorporate in their O&M funding plans provisions for enhanced preventative maintenance and additional spare parts as discussed in paragraph 2.04.a.(7).

(10) Conclusion.

Using a gravity supply system to provide auxiliary water seems attractive because such systems would require minimal electrical requirements and would be separate from the existing pumps. Generally, gravity supply systems are inherently more reliable than pumped systems. However, the requirements for juvenile screening and screen cleaning for the reservoir intake adds complexity and reduces the

reliability of gravity supply system. Maintenance of the reservoir intake screening system would involve the use of divers and would be a time-consuming and expensive process. Also, unless full-flow capacity, as well as backup, is supplied by gravity supply systems, the existing pumps must remain operable.

An energy usage comparison shows that the gravity supply system is very inefficient compared to a pumped system. The energy used by two of the existing pumps for a season of operation is 2,177.4 megawatt (MW) hours (based on two 149 kW (two 200 hp) pumps operated for 24 hours a day for 10 months). The energy lost by using the 14 cms (500 cfs) gravity supply system for a season of operation would be 23,469.2 MW hours, or about 10.8 times as much [based on a head loss of 29m (95 ft) and an 80-percent efficient generator]. Energy recovery generators could be installed in the gravity supply systems, but these would also increase the complexity and expense of the system and reduce the system reliability.

A detailed life-cycle cost comparison has not been performed for a pumped versus gravity supply system. However, the initial cost of the gravity supply system is higher than for upgrading the existing pumps. The O&M cost for the gravity supply system would also include the O&M cost of the existing pumps and, therefore, would be higher than for a pumped system.

Even though a gravity supply system, as described previously, would provide a backup water supply, this alternative is not recommended for implementation because of the high initial construction cost and the high maintenance costs involved.

d. <u>Alternative 4 (Barge Mounted Pumps Shared with Lower Monumental)</u>.

In the Phase I - Technical Report, this alternative proposed two 9.8 cms (350 cfs) barge mounted pumps that could be moved up and down the river and shared with Lower Monumental. This alternative is not being further evaluated due to the difficulty and safety issues involved in tying off a barge along the fish ladder training wall and a cost estimate has not been prepared. Following publication of the Phase I - Technical Report, flip lips have been added to the spillway. These flip lips create high levels of surface turbulence during spilling operations. Also, emptying the navigation lock causes very choppy waters in the vicinity of the training wall that creates a safety hazard.

e. <u>Alternative 5 (Reduce Entrance Width, Upgrade Electrical, and Improve Systems)</u>.

Presently, as discussed in paragraph 2.02.c., the three north shore adult fishway entrances are 3.66 m (12 ft) wide. Only one of these entrances is operated and the other two are closed. The one operating entrance is wider than individual entrances at several dams on the Columbia and Snake Rivers. The FPP does not address entrance width. Therefore, another alternative to improve hydraulic conditions

while fulfilling the FPP criteria is to narrow the entrance to a width comparable to other fishway entrances in the Snake River system. This modification would reduce pump discharge requirements, thereby providing emergency auxiliary water capacity without additional pumps. This modification, combined with the additional improvements discussed below, would provide a one pump equivalent emergency water supply, as well as improved system reliability.

(1) Fishway Entrance Width Reduction and Hydraulics.

One fishway entrance (NSE-1, plate 3) would be reduced from 3.66 m (12 ft) wide to 2.44 m (8 ft) wide. In order for fishway velocities to remain within criteria, a new fishway wall would be installed. It would be a straight wall, extending upstream between NSE-1 and NSE-2, and parallel to the existing channel walls. The wall would end between diffusers 1 and 2. This modification would maintain the channel velocity with less flow across diffuser 1 by decreasing the channel cross section. A detailed hydraulic analysis would be performed during preparation of plans and specifications.

(2) Electrical Upgrade and Redundancy.

Because the existing auxiliary water supply pumps would still be required with this alternative, ensuring reliability would also require some upgrading of the existing pump mechanical and electrical systems. Electrical system upgrade and provision of redundancy similar to that discussed for Alternative 1 in 2.04.a.(2) would be required.

(3) Rebuild Pumps and Appurtenances.

See paragraph 2.04.a.(3) for recommendations regarding Project Operations O&M planning for rebuilding existing components to enhance reliability.

(4) Bulkheads.

As mentioned in paragraph 2.04.a.(4), the addition of bulkheads to isolate the pumps would also be necessary for this alternative.

(5) Diffuser Modifications.

See paragraph 2.04.a.(5), for a description of the modifications to improve the water flow into the fish ladder diffuser 1.

(6) Auxiliary Water Supply Pump Crane and Fishway Entrance Hoist.

As discussed in paragraph 2.04.a.(6), modifications to improve reliability would include installing a permanent crane near the auxiliary water supply pumps and a hoist at the fishway entrances.

(7) Spare Parts and Enhanced Maintenance.

Project Operations would incorporate in their O&M funding plans provisions for enhanced preventative maintenance and additional spare parts as discussed in paragraph 2.04.a.(7).

(8) Conclusion.

The objective of this study is to improve the reliability of the auxiliary water supply system to meet existing FPP criteria. The goal should be to provide the flows required to meet both the submergence and head requirements as stated in the FPP. Even though this alternative improves the Ice Harbor's ability to meet the FPP criteria based on weir depth and weir head differential, it results in an actual reduction in the amount of attraction water leaving the fish entrances. It is therefore not recommended for implementation and a cost estimate has not been prepared for it.

2.05 NORTH SHORE SUMMARY, ESTIMATED COSTS, RECOMMENDATIONS, AND DESIGN AND CONSTRUCTION SCHEDULE.

a. Summary.

Five alternatives for providing an emergency auxiliary water supply for Ice Harbor's north shore adult fishway system were discussed. Alternative 1 proposed an operating criteria revision with several system improvements. Improvements included the following upgrades to the electrical systems: provide redundancy, rebuild existing pumps, add bulkheads, modify diffusers, add crane and hoist, improve spare parts inventory, and enhance maintenance. Alternative 2 proposed a pump upgrade together with other improvements discussed in Alternative 1. Alternative 3 proposed a gravity supply system that would be combined with the existing pumped system. It would also include an electrical system upgrade and system improvements similar to those discussed in Alternative 1. Alternative 4 proposed barge mounted pumps that could be moved up and down the river and shared with Lower Monumental. Alternative 5 proposed a reduced entrance width, thereby requiring less pump discharge. Alternative 5 also included an electrical system upgrade and system improvements similar to Alternative 1.

b. Estimated Costs.

The estimated construction costs for some of the north shore alternatives are shown in table 2-6. Table 2-6 does not include costs for the recommended O&M funded activities. Implementation of any one of these alternatives would require additional funding for E&D and S&A. The O&M and spare parts costs would be determined by Project Operations. The Total Contract Cost Summaries and the Project Indirect Summaries for each alternative are provided in appendix D. The estimates

were prepared using the Microcomputer Aided Cost Engineering System (MCACES) software.

Table 2-6: Estimated North Shore Construction Costs

Alternatives	Construction Cost
1 - Criteria Revision and System Improvements	**$3,423,460**
Electrical Upgrade & Redundancy	$532,989
Bulkheads [1/]	$321,274
Diffuser Modifications [1/]	$300,471
Auxiliary Water Supply Pump Crane	$2,073,438
Fishway Entrance Hoist	$195,289
2 - Upgrade Existing Pumps and System Improvements	**$4,797,941**
Upgrade Existing Pumps [1/]	$1,098,384
Electrical Upgrade & Redundancy	$875,916
Bulkheads [1/]	$292,848
Diffuser Modifications [1/]	$271,799
Auxiliary Water Supply Pump Crane	$2,064,544
Fishway Entrance Hoist	$194,451
3 - Gravity Supply System and System Improvements	**$7,315,475**
Gravity Supply System (total)	$4,104,805
Intake System (Cylindrical Tee Screen)	$1,541,555
Supply Conduit Connection (Cone Valve) [1/]	$2,563,250
Electrical Upgrade & Redundancy	$500,258
Bulkheads [1/]	$280,964
Diffuser Modifications [1/]	$262,117
Auxiliary Water Supply Pump Crane	$1,980,769
Fishway Entrance Hoist	$186,560
4 - Barge Mounted Pumps	**N/A**
5 - Reduce Fishway Entrance Width	**N/A**

[1/] Within each alternative, the costs associated with dewatering the work areas are equally divided between these line items for that alternative.

A 25-percent contingency is appropriate to identify the uncertainty associated with the level of design provided for the construction estimate for the recommended alternative. The Total Contract Cost Estimate (developed at the October 1, 1999, price level) is escalated for inflation through the midpoint of construction based on construction beginning October 2000 and ending September 2002. Midpoint of construction is the first quarter FY 02. The Contract Cost Estimate supports the scope and construction schedule of this Phase II - Technical Report. Total construction costs (escalated to the midpoint of construction) are estimated to be $5,182,000 for the recommended alternative. The total fully-funded costs for the recommended alternative are estimated to be $7,178,000.

c. Recommendation.

Alternative 2 (Upgrade Existing Pumps, Upgrade Electrical, and Improve Systems) is recommended for implementation. The existing pumps should be upgraded to provide at least 8.50 cms (300 cfs) at 1.37 m (4.5 ft) of head. The electrical power supply to the pumps should be upgraded to allow safer and more reliable operation. The pump appurtenances should be rebuilt to keep them operable. Isolation bulkheads should be installed to allow maintenance and repair of any of the pumps while the other pumps are operating. The supply diffusers should be modified to allow more flow into the diffusers at low tailwater. A crane should be installed to perform maintenance on the upgraded pumps and appurtenances. A hoist should be installed at the fishway entrance to allow removal and installation of the entrance gates and weirs for maintenance. An enhanced maintenance program should be employed by the Project Operations. The quantity of spare parts for the pumping system should be increased to the necessary levels by the Project Operations.

d. Design and Construction Schedule.

The schedule for design and construction is dependent on obtaining funding. Considering the current budget cycle, it is anticipated that design funds would first become available in FY 00. Design and award of a construction contract would be completed by the end of FY 00. Construction is anticipated to be complete by the end of FY 02.

2.06. SOUTH SHORE ADULT FISHWAY SYSTEM DESCRIPTION.

a. Auxiliary Water Supply System.

Auxiliary water is supplied by 8 pumps, 2 large conduits, and 17 gated diffusers to supplement the gravity flow from the ladder. Plate 20 shows the basic plan for the south shore adult fishway system.

Eight vertical propeller pumps driven by electric motors provide most of the fish attraction water. The pumps are located on the south shore just downstream from the two main entrance weirs. Each pump is rated at 8.5 cms (300 cfs) at 1.37 m (4.5 ft) of head (pool to pool), and discharges into an open channel. From the discharge channel, the water enters a rectangular concrete conduit, which splits into two branches after about 15.2 m (50 ft). One branch supplies the powerhouse diffusers, which feed into the collection channel. The second branch supplies two diffusers in the short south shore collection channel and the junction pool; as well as the nine diffusers in the fish ladder. These ladder diffusers lie between weirs 338 and 355. All of the diffusers in the south shore system are not controlled. Sluice gates are left open.

The eight pump motors are 186 kW (250 hp), 3-phase, 4,160-V motors that are all fed from a single 4,160-V bus in switchgear, FSP1. Also fed by FSP1 is an

indoor 480-V power center, FSQ1, which supplies pump/motor/gear reducer auxiliaries and fish ladder components. The FSP1 switchgear is in an outdoor cabinet, located adjacent and upstream from the pumps. The switchgear can be fed from either of two station-service breakers over fishway feeder 1 or 2. Each motor is started across the line using a breaker, not a starter.

The Juvenile Fish Facility, constructed in 1996, includes provisions for supplying about 5.1 cms (180 cfs) of water from the facility primary dewatering structure into the lower section of the ice/trash sluiceway. A weir in the sluiceway backs the water up so it flows into the west end of the pump discharge channel to provide additional fish attraction water for the adult fishway systems.

b. Fish Ladder.

The south shore fish ladder 7.32 m (24 ft) wide with a floor slope of 1 vertical to 16 horizontal. At the top of the ladder, a slot and orifice control section regulates flow to 2.66 cms (94 cfs) through the ladder exit for varying forebay elevations.

c. Fishway Collection System.

The collection system on the south shore is more extensive than the north shore system. Entrances at the north end of the powerhouse and floating orifices across the downstream face of the powerhouse allow access for fish to enter the powerhouse collection channel. A short channel, leading from entrance weirs on the south shore, joins the powerhouse collection channel at a junction pool at the base of the fish ladder.

The three entrances at the north end of the powerhouse (NPE-1, NPE-2, and NPE-3) are similar in appearance and operation to the north shore entrances. The NPE-1 and NPE-2 face downstream and NPE-3 opens into the spillway stilling basin. Only NPE-2 is operated under normal conditions. The SSE-1 and SSE-2 are similar in appearance and operation to the other downstream-facing entrances. Normally only SSE-1 (closest to the powerhouse) is operated, while SSE-2 is closed (plate 20).

d. Original Operating Criteria.

The system was originally designed to operate with the water surface in the collection channel 228.6 mm (9 in) above the water surface upstream of the entrance weirs. The head over the entrance weirs was 76.2 mm (3 in). Thus, the water surface in the collection channel was 304.8 mm (1 ft) above tailwater. Two pairs of wing gates in the main collection channel and one pair in the short channel leading to the south shore entrance weirs were installed to help maintain this higher water surface elevation in the collection channel.

e. Current Operating Criteria.

Current operating criteria requires the head on the entrance weirs to be between 304.8 and 609.6 mm (1 and 2 ft). The wing gates are still in place but are not used because it is no longer necessary to maintain a difference in head between the collection channel and the entrance weirs. All the main entrance weirs are operated to meet the same criteria pertaining to weir depth and head differential as the north shore entrances.

2.07. EVALUATION OF THE EXISTING SOUTH SHORE AUXILIARY WATER SUPPLY SYSTEM.

a. Pump Capacity Limitations.

The south shore system is operated using six to eight pumps depending on tailwater elevation. Spare capacity has ranged from 0.6 pump-equivalent (based on the water from the juvenile fish dewatering facility noted above) up to an additional 2 pump-equivalent. See table 2-7 for the south shore pump system requirements. Spare capacity estimates and the data in table 2-7 are based on the following assumptions and on observations of the system as it operated during 1992 through 1995.

(1) The system was assumed to be operating as designed with all pumps producing their rated discharge of 8.5 cms (300 cfs) at 1.4 m (4.5 ft) of head.

(2) The tailwater elevation across the powerhouse was assumed to be uniform.

(3) It was assumed that the entrance weirs would be on sill when tailwater is 103.6 m (340 ft) or less and that there would be 2.4 m (8 ft) of submergence when the tailwater is above 103.6 m (340 ft).

(4) Based on observations, when the system was operating as designed, the head differential across the entrance weir at the south shore was 427 mm (1.4 ft) while the differential at the north powerhouse entrance was 305 mm (1.0 ft).

(5) The discharge of the floating orifices was based on the average head differential between the south shore entrance and the north powerhouse entrance. The discharge was also based on the assumption that 7 of 12 floating orifices were operating.

Even though a one-pump equivalent of spare pump capacity may not be available at all times, the loss of a single pump would result in only about a 12-percent reduction in flow. Eight pumps are not required very often to meet the FPP criteria, even though the Ice Harbor personnel often run all eight pumps. The risk to

fish passage with a single pump down would be small. Therefore, additional spare hydraulic capacity is not required on the south shore.

TABLE 2-7: South Shore Pump Requirements

Tailwater		Weir Submergence		Combined Discharge of SSE and NPE and 7 Floating Orifices		Without Juvenile Water Add-In			With Juvenile Water Add-In		
						Pump Discharge		Required Number of Pumps	Pump Discharge		Required Number of Pumps
ft	m	ft	m	cfs	cms	cfs	cms		cfs	cms	
337.5	102.9	5.3	1.60	1,565	44.32	1,471	41.66	5	1,291	36.56	5
338.0	103.0	5.8	1.75	1,680	47.58	1,586	44.92	6	1,406	39.82	5
339.0	103.3	6.8	2.06	1,912	54.15	1,818	51.49	7	1,638	46.39	6
340.0	103.6	7.8	2.36	2,145	60.75	2,051	58.09	7	1,871	52.99	7
340.3	103.7	8.0	2.44	2,203	62.39	2,109	59.73	8	1,929	54.63	7
341.0	103.9	8.0	2.44	2,035	57.63	1,941	54.97	7	1,761	49.87	6
342.0	104.2	8.0	2.44	1,923	54.46	1,829	51.80	7	1,649	46.70	6
343.0	104.5	8.0	2.44	1,849	52.36	1,755	49.70	6	1,575	44.60	6
344.0	104.8	8.0	2.44	1,796	50.86	1,702	48.20	6	1,522	43.10	6
345.0	105.2	8.0	2.44	1,757	49.76	1,663	47.10	6	1,483	42.00	5
346.0	105.5	8.0	2.44	1,730	48.99	1,636	46.33	6	1,456	41.23	5
347.0	105.8	8.0	2.44	1,706	48.31	1,612	45.65	6	1,432	40.56	5
348.0	106.1	8.0	2.44	1,687	47.78	1,593	45.11	6	1,413	40.02	5
349.0	106.4	8.0	2.44	1,668	47.24	1,574	44.58	6	1,394	39.48	5
350.0	106.7	8.0	2.44	1,658	46.96	1,564	44.29	6	1,384	39.20	5
351.0	107.0	8.0	2.44	1,652	46.79	1,558	44.12	6	1,378	39.03	5
352.0	107.3	8.0	2.44	1,648	46.67	1,554	44.01	6	1,374	38.91	5

b. Mechanical Reliability.

There is ready access for minor system maintenance. Major maintenance requiring pump removal would require a rented crane. Because of overhead line clearances, reach distances, and boom angle restrictions, the existing project crane cannot be used. Overhead line clearance limitations may require a high-voltage line outage during the removal activity. The pumps and speed reducers are over 35 years old and are at the end of what is normally considered the useful operating life for this type of equipment. The motors are of heavy-duty construction and appear to be in good, smooth-running condition. They are estimated to have a remaining life span of about 25 years with good maintenance. Five of the speed reducers have been rebuilt. None of the pumps have been removed. The pump motors have had bearings replaced

multiple times as they do not have oil lubricated bearings. Ice Harbor does not have a complete set of spare parts for the pump system.

c. Electrical Reliability.

The existing dual station-service should be a reliable power source, except in a plant blackout. The greatest system weakness is the lack of redundancy of the single bus FSP1 switchgear. A fault on this single bus could cause severe damage to the switchgear, preventing operation of all eight pumps for an extended period. Compounding this weakness is the use of breakers instead of starters to start pump motors. As discussed for the north shore deficiencies, breakers are not designed to handle repetitively the transient conditions encountered during across the line starting. Across the line starting of large loads also places greater stress on motors and mechanical loads. With each additional breaker operation, the chance of a major failure at the switchgear increases. Since breakers are operated locally, such a failure could expose operating personnel to serious injury.

2.08. SOUTH SHORE AUXILIARY WATER SUPPLY SYSTEM IMPROVEMENT ALTERNATIVES.

As discussed in paragraph 2.06.a., additional spare hydraulic capacity is not required on the south shore. However, system reliability must be improved to assure continued operation within current system capacity. Alternatives are presented below for improving electrical and mechanical reliability:

a. Alternative 1 (Electrical System Upgrade).

Two major electrical system modifications could provide an improvement in electrical reliability. These modifications are as follows:

One would be to replace the existing FSP1 switchgear with new switchgear having a split bus arrangement with a tie breaker. Each bus would be fed from one of the existing dual feeders from station service. The sub-feed to power center FSQ1 could be configured in a dual arrangement to allow connection to either half of the FSP1 bus. The split bus arrangement would ensure that a single bus or feeder failure would affect no more than four pumps. This would not provide for the single pump equivalent backup, but it would be an improvement over the existing system. Historically, the likelihood of a major bus failure is extremely small.

The other improvement would consist of providing medium-voltage starters in the new switchgear for the eight pump motors. Starters could be operated from a remote location, reducing any potential for injury due to a catastrophic failure in the medium-voltage switchgear. Annunciation would be connected into the powerhouse control room for remote monitoring. These starters could be either "across the line" type starters or solid state "soft-start" type motor controllers with bypass contactors.

Motor starters have a higher duty cycle rating than existing breakers and can be expected to provide more reliable long-term performance. Soft-start controllers put less stress on the switchgear, motors, and pump components than starting "across the line." Bypass contactors in these controllers remove the solid state components from the system after soft-start, increasing the life of the solid state devices, reducing heat rejection to the spaces adjacent to motor starters, and reducing harmonics induced on the electrical system. Either type starter would reduce the likelihood of a destructive failure in the switchgear. Further analysis and selection of the starter type would be accomplished during design. The cost estimate is based upon soft-start controllers. See plate 21 for a partial one-line diagram showing the existing, as well as the improved switchgear configurations.

Both improvements would require the associated water supply system to be shutdown for approximately 2 to 3 months. This period could be used to accomplish any major mechanical equipment maintenance on the system as well. The work would be scheduled during a slow adult fish migration period and the north shore system would remain operational during the south shore system work.

While this alternative would increase the reliability of the pump electrical system and allow the project to operate closer to the FPP criteria in the event of an electrical fault, it does not address improving the reliability of the existing pumps and appurtenances. Therefore, this alternative is not recommended for implementation.

b. Alternative 2 (Improve Reliability through Enhanced Preventive Maintenance and Increased Spare Parts Inventory).

This alternative would be a responsibility of Project Operations and would require increased funding through the O&M budget planning process. An enhanced preventative maintenance program in addition to an increased inventory of spare parts would substantially contribute to the reliability of the adult fishway systems. The object of the program would be to anticipate possible failures and work to prevent them through preventative maintenance. Renting a crane for removal of major components could be anticipated and scheduled where it would be needed for preventative maintenance. The increased parts inventory would allow the project to be prepared to resolve most problems in a timely manner. Such spare parts could include, but would not be limited to, a spare gear set or gear box, two spare motors with oil lubricated bearings, replacement oil lubricated type bearings for existing motors if available, a new grease system, a butterfly valve operator hydraulic pump, and new electrical alarms. See table 2-3 for a general list of typical spare parts. Appendix H contains a list of O&M backlog work items.

While this alternative would increase the reliability of the pump system and allow for quicker repair of failed pump equipment and appurtenances, it does not address the lack of starters or the single bus arrangement of the electrical power source for the existing pumps. A failure of the electrical power system could result in

no pumps being operable. Therefore, this alternative is not recommended for implementation.

c. Alternative 3 (Electrical System Upgrade, Enhanced Preventive Maintenance, and Increased Spare Parts Inventory).

This alternative is the combination of Alternatives 1 and 2. Under this alternative, the pump electrical systems would be upgraded as described in Alternative 1, and an enhanced preventative maintenance program would be employed with an increased spare parts inventory as described in Alternative 2. This alternative addresses the electrical reliability issue and the continued use of existing equipment with increased preventative maintenance and spare parts. Also, as described previously, this alternative would provide between 0.6 and 2 pumps equivalent of backup water supply. This alternative is recommended for implementation.

2.09 SOUTH SHORE SUMMARY, ESTIMATED COSTS, RECOMMENDATIONS, AND DESIGN AND CONSTRUCTION SCHEDULE.

a. Summary.

Three alternatives for the south shore adult fishway systems were discussed. Alternative 1 proposed an electrical system upgrade providing new switchgear with a split bus arrangement including medium-voltage starters. Alternative 2 proposed improved reliability through enhanced preventive maintenance and increased spare parts inventory, funded through the O&M program. Alternative 3 proposed a combination of Alternatives 1 and 2.

b. Estimated Costs.

The estimated construction costs for the construction general portions of the south shore alternatives are shown in table 2-8. Table 2-8 does not include costs for the recommended O&M funded activities. Implementation of Alternative 1 or 3 would require additional funding for E&D and S&A for the construction general portions. The O&M and spare parts costs would be determined by Project Operations. The Total Contract Cost Summary and the Project Indirect Summary for the construction general portion of the recommended alternative are provided in appendix E. The estimate was prepared using the MCACES software.

A 25-percent contingency is appropriate to identify the uncertainty associated with the level of design provided for the construction estimate for the recommended alternative. The Total Contract Cost Estimate (developed at the October 1, 1999, price level) is escalated for inflation through the midpoint of construction based on construction beginning October 2002 and ending September 2004. Midpoint of construction is the first quarter FY 04. The Contract Cost Estimate supports the scope and construction schedule of this

Phase II - Technical Report. Total construction costs for the CG portion, escalated to the midpoint of construction, are estimated to be $2,109,000 for the recommended alternative. The total fully-funded costs for the recommended alternative are estimated to be $2,921,000.

Table 2-8: Estimated South Shore System Construction Costs

Alternative	Estimated Construction Cost
1 - Electrical System Upgrade	$1,855,455
2 - Improve Reliability	O&M Budget
3 - Electrical System Upgrade & Improve Reliability	$1,855,455 plus O&M Budget

c. Recommendations.

Alternative 3 is recommended for implementation. The electrical power supply to the pumps should be upgraded to allow safer and more reliable operation. Project Operations should inspect all pertinent systems and develop any required maintenance schedules or spare parts inventory requirements for inclusion in O&M funding plans. This would include plans for replacement, refurbishment, or rebuilding to return systems to original condition.

d. Design and Construction Schedule.

The schedule for design and construction is dependent on obtaining funding. Considering the current budget cycle, it is anticipated that design funds would first become available in FY 00. Design and award of a construction contract would be completed by the end of FY 00. Construction is anticipated to be complete by the end of FY 04. This schedule would allow two seasons to complete the work and would not require both north and south shore adult fishway systems to be shutdown simultaneously.

SECTION 3 - LOWER MONUMENTAL

3.01. GENERAL.

Lower Monumental, completed in 1969, is located on the lower Snake River at river kilometer 66.9 (mile 41.6). The normal range of forebay pool elevations is 163.7 to 164.6 m (537 to 540 ft) msl. The tailwater elevation typically varies between 133.2 to 136.6 m (437 to 448 ft). The adult fishway system consists of an auxiliary water supply system, fish ladders, and collection systems. The collection systems and fish ladders are operated on both the north and south shores. The auxiliary water supply system is shared by both fish ladders.

3.02. ADULT FISHWAY SYSTEM DESCRIPTION.

a. Auxiliary Water Supply System.

The water supply system for the north and south shore fish ladders and fishway entrances have three water sources: gravity flow coming down the fish ladders, a pumped auxiliary water supply system, and excess water from the juvenile fish bypass dewatering facility. The combination of these sources provides adequate fish attraction water flows at the ladders and collection channel entrances (plates 23 and 24).

Three turbine-driven pumps located in the erection bay supply most of the auxiliary water supply for all ladder entrances. The three units consist of hydraulic Francis turbines, speed reducers, and axial flow fixed blade propeller pumps. Each unit is rated to deliver up to 24 cms (850 cfs) at a water-to-water pump head of 1.2 m (4 ft) and at a turbine gross head of 27.4 m (90 ft). The pumps discharge into an open atmosphere chamber. Normally, all three turbine pumps are operated in manual mode. (Their controls were designed to allow two to be operated in manual with the third controlled in automatic according to tailwater elevation.)

The hydraulic turbine water supply system consists of a single 1 200-mm-diameter (48-in-diameter) penstock leading from the upstream face of the dam down to near the turbines where it divides into three 760-mm-diameter (30-in-diameter) laterals that supply water to the turbines. The 1 200-mm-diameter (48-in-diameter) penstock transitions to a 1.96- by 2.43-m (77- by 96-in) opening at the upstream face of the dam. Guides embedded in the upstream face of the dam allow lowering a trashrack or bulkhead over the penstock entrance from the deck of the dam. The penstock has an air backwash system to remove debris from the trashrack.

Excess water from the juvenile fish bypass dewatering facility downwell drain line discharges into the pump chamber, adding approximately 5.1 cms (180 cfs) to the water supply system.

From the open-atmosphere pump discharge chamber the water enters three different supply conduits. One conduit supplies diffusers located along the powerhouse collection channel and near the SPE. The other supplies diffusers located in the lower sections of the north shore fish ladder and near the NSE. The third conduit, the south shore fishway water supply conduit, supplies water through diffusers to the south shore collection channel. This supply conduit runs along the downstream side of the powerhouse, upstream to the spillway, across the spillway, and then downstream to the south shore diffusers. A regulating tainter gate within the conduit at the south end of the powerhouse is used to help control flow to the south shore entrances (plate 24).

Electrical power to control fishwater turbine pumps and to power critical elements of the pump and fishway systems is provided from station service and from the powerhouse battery bus. The FSC Switchboard contains the central control, indication, instrumentation, and relay equipment for the operation of the fishwater pumps.

b. Fish Ladders.

The north shore fishway ladder is 4.88 m (16 ft) wide and has a floor slope of one vertical to ten horizontal. A control section at the top of the ladder regulates the flow down the ladder at about 2.10 cms (74 cfs) for varying forebay pool elevations.

The south shore fishway ladder is 4.88 m (16 ft) wide and has a floor slope of one vertical to ten horizontal. A control section at the top of the ladder regulates the flow down the ladder at about 2.10 cms (74 cfs) for varying forebay pool elevations.

c. Fishway Collection System.

There are two 1.2-m-wide (4-ft-wide) entrances located immediately downstream from the erection bay on the north shore. These entrances are overflow weirs with gate heights of 5.5 m (18.0 ft) and sill elevations at 130.8 m (429.0 ft) msl. These fish ladder entrances can be adjusted for depth of submergence to maintain the proper fish attraction water flow. The collection channel invert upstream of these entrances gradually transitions from elevation 130.8 m (429.0 ft) at the sills to elevation 131.7 m (432.0 ft) at diffuser 2B. A junction pool at the lower end of the north shore ladder divides the flow to the fish ladder entrances and the fish collection channel.

The fish collection channel runs along the downstream face of the powerhouse and has 10 floating weir orifices. Only five of the floating weir orifices are used and the remainder are bulkheaded closed. The operating orifices have openings 610 mm (2 ft) high by 1.8 m (6 ft) wide with buoyancy tanks used to maintain the orifice center line at roughly 1.2 m (4.0 ft) below tailwater.

There are three 1.8-m-wide (6-ft-wide) entrances located at the south end of the powerhouse just downstream from unit 6. Presently, the two downstream entrances

are operated with the side entrance not used. Entrances SPE-1 and SPE-2 are overflow weirs with gate heights of 4.7 m (15.5 ft) and sill elevations at 131.7 m (432.0 ft). Entrance SPE-3 is a lift gate entrance with a gate height of 3.4 m (11.1 ft) and a sill elevation at 131.7 m (432 ft). The collection channel extends from the entrances at the south end of the powerhouse to the entrances and fish ladder on the north shore.

There are three 1.8-m-wide (6-ft-wide) entrances located near the downstream end of the stilling basin on the south shore. A south shore collection channel and diffusers connect the south shore entrances to the south shore fish ladder. Presently, the two downstream entrances are operated with the side entrance not used. Entrance SSE-1 is an overflow weir, and SSE-2 is a lift gate entrance acting like a sluice gate under present operations. Both gate heights are 4.4 m (14.5 ft) with sill elevations at 131.4 m (431.0 ft).

Most fishway entrance gates are controlled by a Programmable Logic Controller located in the powerhouse control room, with a data highway link to three remote I/O panels at the fishway entrances. The SSE-2 and SSE-3 are operated manually. Station service power to operate the south shore entrances is distributed from switchgear LSP2-LSQ2 (located in the navigation lock substation room) to control center FQ1 (located near the entrances).

3.03. EVALUATION OF THE EXISTING AUXILIARY WATER SUPPLY SYSTEM.

a. Pump Capacity Limitations.

All three fishway turbine pumps are operating full-time attempting to meet the FPP criteria. There is no emergency auxiliary water supply available to sustain operation within criteria in the event of a pump failure. There appears to be a mismatch of pumping system components. Project personnel have not been able to obtain the rated pump speed or wicket gating opening. The maximum flow available out of the pumps appears to be about 19.8 cms (700 cfs) each instead of the 24 cms (850 cfs) design flow. The actual pump performance does not appear to match the manufacturer's pump curves. Even though the pumps appear to have reduced capacity, Lower Monumental is able to stay within the FPP criteria most of the time with all three pumps running.

b. Mechanical Reliability.

The fishway turbine pumps are gravity fed and require only low-voltage electrical power. Individual pump chambers can be isolated and dewatered for maintenance by using the intake and discharge bulkheads. When only two pumps are running, the third pump is isolated with bulkheads, thereby preventing reverse flow through it. The water turbines appear to be in fairly good condition, and their remaining life span is estimated to be longer than 25 years. One turbine is new and the others

were rebuilt during 1994 and 1995. The turbine grease systems were replaced, and the wicket gates were overhauled. The gearboxes and pumps are in fairly good condition but may be near the end of their useful life span. Annual preventative maintenance and necessary repairs are about the only work that has been done on the gearboxes and pumps.

The hydraulic turbine intake penstock has an air backwash system to remove debris from the trashrack. Trashrack plugging reduces the pumping capacity of the pumps. The original system was not effective in cleaning the lower portion of the trashrack. Project personnel recently installed additional air backwash piping to the trashrack to improve their cleaning ability. The additional backwash piping allows the entire trashrack to be cleaned. Backwash is performed at night and is necessary every few weeks during the operating season. The penstock must be removed from service during backwash events. This system has been in operation for over a year and has worked very well.

c. Electrical Reliability.

Electrical power is used only for support functions and instrumentation. The 480-V station service power distribution sources for the auxiliary water pumps are fed from dual bus systems. Therefore, any potential for outages from loss of 480-V power would involve electrical equipment located the farthest from the power source that should be readily available in the marketplace. This equipment has proven very reliable and could be repaired in a period measured in hours or days.

Turbine intake butterfly valve operators are direct current (dc) powered so that emergency shutdown is possible without 480-V power. These operators will automatically shutdown the associated turbine pump when any of the following conditions occur:

- The 480-V alternating current (ac) supply to controls, wicket gate operators, and other auxiliaries are interrupted for more than 35 seconds.
- The speed reducer oil pump fails for 35 seconds.
- Any lockout relay indicates high temperatures of the turbine, speed reducer, or pump bearing oil.
- A loss of pump thrust bearing oil pressure.

Any of these conditions could result in an extended auxiliary water pump outage if not alarmed and then corrected. In addition, the loss of wicket gate power or control could lead to a turbine pump overspeed condition if not corrected. Therefore, the shutdown features are absolutely essential.

Powerhouse blackouts are extremely rare, but when they have occurred, they have lasted for less than an hour. For an operator who is dealing with a blackout occurrence, restarting auxiliary water pumps is of lesser priority than preventing powerhouse flooding and preserving powerhouse systems integrity.

Providing backup power from the powerhouse emergency generator would not improve reliability since, as noted above, in a situation where the emergency generator would be energized, the auxiliary water pumps would not be an operator's primary concern. The generator is connected to station service ahead of the dual bus feeds, so other distribution options are already available when not in a blackout situation.

The butterfly valve operators used for emergency shutdown are powered from the powerhouse battery bus. Therefore, the battery system and its distribution features are critical to protecting the auxiliary water pumps from damage. The battery system has proven to be a reliable system.

3.04. AUXILIARY WATER SUPPLY SYSTEM IMPROVEMENT ALTERNATIVES.

Several alternatives for improving the reliability of the existing auxiliary water supply and for providing additional emergency water supply were recommended for further investigation in the Phase I - Technical Report. They were summarized in the introduction of this Phase II - Technical Report. The following discussion addresses the Phase I - Technical Report recommended alternatives. It also presents modified versions that were investigated further.

a. Alternative 1 (South Shore Water Supply Pumping System).

An alternative that would add pumps on the south shore was discussed in the Phase I - Technical Report, but was not recommended for further investigation in that report due to accessibility for construction and maintenance. Further investigation revealed that a modified south shore pumping alternative would be better than the system proposed in the Phase I - Technical Report. This system is comprised of a revised pump location and a scheme of operation that would separate the existing auxiliary water supply system into north and south auxiliary water supply systems. This modified system is presented below.

(1) General Description.

This alternative would separate the existing auxiliary water supply system into north and south shore auxiliary water supply systems. The regulating tainter gate located at the south end of the powerhouse in the south shore auxiliary water supply conduit would remain closed, to be used only as an emergency water supply connection between fishways. The north shore entrances would continue to utilize the existing hydraulic turbine-driven pumps. A new auxiliary water supply

pumping system would be added on the south shore to supply the auxiliary water supply at the south shore entrances. The existing computerized fishway control system would be upgraded so that north and south auxiliary water supply systems would operate independently.

In addition to the improvements listed above, Project Operations would incorporate in their O&M funding plans provisions to maintain or replace components of existing features where hydraulic conditions could be improved. Spare parts inventories for fishway systems' critical components could be increased to improve turnaround times and enhance reliability. Appendix H contains a list of O&M backlog work items. Examples of potential feature improvements are:

- Refurbish entrance gates and operators to reduce leakage.

- Replace floating orifice gate seals.

(2) South Shore Pumping System.

The new pumphouse would be constructed between the fish ladder and the navigation lock. A temporary cofferdam would be constructed to allow construction of the pumphouse between the base of the fish ladder and the navigation lock. After unwatering the area, the existing rockfill would be removed, and the bedrock under the rockfill would be excavated to a depth of approximately 1.5 m (5 ft). The structure would then be constructed of reinforced concrete and would be structurally independent of the navigation lock and the fish ladder. The pumphouse walls would have a 25-mm (1-in) gap between the navigation lock on one side, and the fish ladder on the other side. This would allow any movements occurring in the navigation lock monoliths or the fish ladder to take place without harming the pumphouse. To counteract uplift pressures and prevent overturning, the floor slab of the pumphouse would be anchored down to the bedrock using thirty-five 32-mm-diameter (1.25-in-diameter) rock anchors.

A bulkhead would be provided for dewatering the pumphouse for maintenance or repairs. The bulkhead would be constructed to fit in the trashrack slot (plates 25 and 26). A hoist would be provided for handling the bulkhead and trashrack. Because the pump intake would be shallow, fish screens would be installed on the pump intake to keep juvenile fish out of the system. Screen cleaning provisions would be provided to keep the intake screens clear of debris. The intake screens and screen cleaning systems are not shown on the plates.

The connection between the new pump and the water supply conduit would be made using a 3 048-mm-diameter (120-in-diameter) epoxy lined and coated steel pipe. The pipe would penetrate the side of the water supply conduit adjacent to the diffusers going into the fish ladder.

(a) New Pump.

The pump system, described in the Phase I - Technical Report, used two 9.9 cms (350 cfs) pumps. Based on the space restrictions, and to reduce O&M costs, it was decided to use one 19.8 cms (700 cfs) pump instead of two 9.9 cms (350 cfs) pumps. The pump would be a vertical propeller pump similar to the existing auxiliary water supply pumps in the powerhouse. There is no need for two pumps for redundancy, because the three existing auxiliary water supply pumps would still be part of the system. The regulating tainter gate in the water supply conduit could be reopened for emergencies or maintenance if needed.

(b) Access.

Access to the site where the pumphouse would be constructed would be limited to two methods. Access from barges that can fit under the fish ladder and between the fish ladder support columns, or access from the top of the navigation lock using a large crane. Personnel access is possible by using the existing personnel elevator from the top of the dam and walking over to the pumphouse.

(3) South Shore Electrical.

There is currently insufficient power available on the south shore to feed the proposed pumping system. A new 5 kV feeder would be required between a new breaker in the station service SP gear in the powerhouse to the new pump location. Since this pump system would be backed up by a spare turbine pump on the north shore, a dual feeder would not be required. This feeder would be installed approximately 427 m (1,400 ft) in existing cable tray, 30.5 m (100 ft) in vertical cable shaft, and 152 m (500 ft) in new rigid steel conduit. A breaker and medium-voltage starter in a weatherproof cabinet would be located near the pump. A distribution transformer and low-voltage equipment would be installed to provide for local loads (*e.g.,* lighting, controls, and cabinet heaters).

Existing solid state controls for the south shore entrance gates would be modified as necessary to allow operation independent from the north shore system. Remote control and annunciation for the new pump would be incorporated with the existing programmable controller system.

(4) Conclusion.

This alternative would provide a backup water source with minimal disruption. It has the advantage of reducing the hydraulic losses created by delivering water through the south shore water supply conduit all the way from the north shore. It also provides the economic benefit of providing two independent systems that share a common emergency backup source (one of the existing turbine pumps). However, there is an accessibility problem, which would require the addition of a crane near the

south shore equipment. The juvenile screens on the pump intake would require screen cleaning provisions with their inherent complexity and potential reliability problems. Due to the additional requirement for crane and screens and the associated increased maintenance and construction costs, implementation of this alternative is not recommended.

b. Alternative 2 (Gravity Supply System Through South Nonoverflow Section).

In the Phase I - Technical Report, a version of this alternative was proposed based on developing 19.8 cms (700 cfs) additional flow. It assumed a shared water supply between the north and south shore fishway ladders and collection channel, as presently operated. The alternative described below would operate the north and south auxiliary water supply systems independently.

(1) General Description.

This alternative would separate the existing auxiliary water supply system into north and south shore auxiliary water supply systems by closing the regulating tainter gate at the south end of the powerhouse. The north shore and powerhouse entrances would continue to use the existing turbine pumps.

A new gravity supply system would be installed at the south nonoverflow section to provide up to 19.8 cms (700 cfs) auxiliary water supply for the south shore entrances. The new gravity supply system would include a screened reservoir water intake system mounted to the upstream face of the dam and a 2 100-mm-diameter (84-in-diameter) epoxy lined and coated steel supply pipe through the south nonoverflow section of the dam (plate 31). The supply pipe would connect to a new pressure reducing sleeve valve located in the existing south shore auxiliary water supply conduit.

Separating the auxiliary water supply system by closing the regulating tainter gate at the south end of the powerhouse would allow the north shore and powerhouse auxiliary water supply systems to operate using just two of the existing turbine pumps. The regulating tainter gate could be opened and all three turbine pumps operated to provide a backup water source for the south shore gravity supply system. Thus, the primary auxiliary water supply sources would be two of the existing turbine pumps and the new gravity supply system. The emergency auxiliary water supply source would be one of the existing turbine pumps.

This alternative would also include upgrading the fishway control system as discussed in Alternative 1.

In addition to the improvements listed, Project Operations would incorporate in their O&M funding plans provisions to maintain or replace components of existing features where hydraulic conditions could be improved. Spare parts

inventories for fishway systems' critical components could be increased to improve turnaround times and enhance reliability. Appendix H contains a list of O&M backlog work items. Examples of potential feature improvements are:

- Refurbish entrance gates and operators to reduce leakage.
- Replace floating orifice gate seals.

(2) Reservoir Water Intake System.

The primary component of the gravity supply system is the screened intake. Two types of screened intake systems were considered. A multiple tee screen type intake system and a large drum screen intake system. Trashracks would not be installed in front of either of the reservoir water intake screen systems. The screens would be submerged at all times and would not be subject to damage by floating debris. The water current in the vicinity of the screens would not be very high and would not subject the screens to impact by submerged debris. Similar intake screen systems are commonly installed in rivers without trashracks. Also, trashracks would themselves require some sort of cleaning system. Warning signs would be posted directing surface vessels to stay clear of the submerged intake screens.

(a) Multiple Tee Screen Type Intake System Discussion.

A multiple tee screen intake system, similar to the one considered at Ice Harbor, was briefly investigated. The tee screens proposed for Ice Harbor are the largest commercially available. A minimum of eight such tee screens would be necessary at Lower Monumental to supply up to 19.8 cms (700 cfs). Installing that many tee screens at Lower Monumental would place the southern-most tee screen in front of the fish ladder exit and the northern-most tee screen near the spillway. The tee screen in front of the fish ladder exit could interfere with fish leaving the fish ladder. The tee screen near the spillway could be subjected to damaging debris during spill events. Therefore, installing a tee screen-type reservoir intake system was not considered further.

(b) Drum Screen Intake.

The drum screen would be 8.16 m (26.8 ft) long and 7.93 m (26 ft) in diameter. The ends of the drum screen would be steel plate except at the supply pipe connection. Stainless steel wedge wire bar screen panels would be bolted around the sides of the drum. The wedge wire would be sized based on 2-mm-wide (0.079-in-wide) slots, 0.12 mps (0.4 fps) approach velocity and 50 percent open area. An internal perforated pipe would be installed with the perforation configuration determined by computer modeling to provide equal flow velocities through all the screen area (plate 34).

(c) Drum Screen Support Frame.

A structural steel frame mounted to the upstream face of the dam would support the drum screen. The support frame would be secured to the dam with adhesive anchors. The support frame would be assembled on shore and moved into position as a single unit (plate 35). Underwater ferrous surfaces would be epoxy coated and cathodically protected to prevent corrosion.

(d) Drum Screen Drive System.

To provide cleaning, the drum screen would be rotated at about 0.1 revolution per minute by an electric motor located at the deck of the dam with a drive shaft extending down to the drum screen. Universal joints suitable for submerged operation would be used to align the drive shaft so a submerged gearbox would not be required. The drum screen drive motor is estimated to be 1 kW (1.3 hp) or less. The underwater portions of the drum screen drive system would require the use of divers during maintenance activities.

(e) Drum Screen Backflush System.

The drum screen would be cleaned by a backflush system that would continuously draw water backward through a portion of the screen using gravity flow. This reverse flow would occur along narrow longitudinal backflush slots at one radial location on the circumference of the drum as the drum rotated past. The longitudinal backflush slots would be along the length of a backflush intake pipe parallel and adjacent to the intake drum (plate 38). The backflush piping would be routed through the south nonoverflow section of the dam and would drain into the water supply conduit. Alternately, the backflush piping could be routed directly to the tailrace. The most suitable routing would be investigated during preparation of plans and specifications. Differential pressure sensors would be installed across the screen so screen plugging could be monitored.

The backflush intake slots would have brushes and ultra-high molecular weight polyethylene wear shoes along their length to help remove debris. The wear shoes would block off the intake screen adjacent to the intake slots to prevent localized high through-screen velocities. The backflush system would be primarily designed to remove small debris clinging to and between the wedge wire bars that was not brushed off. Debris removed by the brushes would settle to the bottom of the reservoir. Large debris settling onto the top surface of the drum would fall off as the drum rotated. The intake slots and intake pipe would be able to rotate away from the screen for maintenance and repair. The intake slots would be held against the screen by spring tension and generated suction. Maintenance and repair of the backflush system in the reservoir would require the use of divers.

An electric motor operated pinch valve would control the backflush flow rate. The pinch valve operator motor is estimated to be 1 kW (1.3 hp) or less. A flow meter would be installed downstream of the pinch valve to measure the backflush flow rate. Pinch valves were selected because they are most suitable for throttling debris-laden water. The backflush through-screen velocity at the backflush slot would be approximately 2 mps (7 fps) with 0.39 cms (14 cfs) of backflush flow.

Air burst backwash cleaning systems would not be as effective in this application as the brush and backflush system. Because the gravity supply system would be a primary source for auxiliary water supply, it should be able to operate for long periods of time without shutdown. Air burst backwash cleaning systems would disrupt the water flow while operating. They also work best when there is some cross flow to carry away loosened debris. There would not be much cross flow in the vicinity of the drum type intake screen system.

(f) Drum Screen Installation.

The supply pipe connection at the outlet of the drum screen would be designed with a sliding connection assembly to allow drum screen installation and removal with a minimum of underwater work. The sliding piece would be retracted during removal and installation of the drum screen and extended for drum screen operation. Retracting and extending the sliding piece would simultaneously disengage and engage the drum screen drive shaft (plate 36). Divers would be required to observe the installation and removal of the drum screen during maintenance activities. Crane access to the drum screen would be by mobile crane from the deck of the dam.

The drum screen and upstream and outlet bearing assemblies would be installed and removed as a single unit. After lowering the drum screen into position, the sliding assembly would be extended and the backflush slots rotated into position against the screen. Inflatable seals would be used to seal the gaps between the sliding assembly and the supply pipe. Pneumatic cylinders suitable for submerged operation would be used to position the sliding assembly and rotate the backflush slots. The design would allow the cylinders to be retracted while the drum screen was in use to minimize the cylinder rod exposure to the water.

(g) Drum Screen Isolation Valve.

A hydraulically actuated 2 100-mm-diameter (84-in-diameter) knife gate valve suitable for submerged operation would be installed in the supply pipe between the drum screen and the dam. This valve would serve as the isolation valve for the water supply system. A hydraulic system would be used rather than a pneumatic one because of the high pressures needed to operate the valve. The oil used in the hydraulic system would be the same type as that used in the regulating tainter gate hydraulic system. The hydraulic power unit for the knife gate valve is estimated to be 1 kW (1.3 hp) or less. The hydraulic power unit is not shown on the

plates, but it would be of the standard commercial design for this type of application. Lockout, oil level monitoring, and other safety devices would be incorporated into the design to prevent unauthorized valve movement.

(h) Temporary Bulkhead.

A temporary bulkhead would be installed on the upstream face of the dam during installation of the supply pipe through the dam (plate 30). The opening for the supply pipe would be tunneled through the dam into the back of the bulkhead. The supply pipe would be installed and grouted in place. A blind flange would be installed on the downstream end of the pipe just outside of the concrete. The temporary bulkhead would then be allowed to fill with water and removed. The drum screen isolation valve would be installed on the upstream end of the pipe and closed. The water would be drained from the pipe through the dam, and the blind flange on the downstream end of the pipe would then be removed. The remaining supply pipe to the auxiliary water supply conduit connection would then be installed.

(3) Supply Conduit Connection

The connection to the south shore auxiliary water supply conduit would be made just downstream of the south nonoverflow monoliths (plate 31). The rockfill above the conduit at the connection would be penetrated with a pipe downwell and the rockfill removed from inside the downwell. A hole would be cut in the top of the conduit for connecting the downwell. A sleeve valve would be installed in the downwell and connected to the supply pipe coming through the dam. Sleeve valves of this type are the recommended industry standard for breaking heads of this magnitude [30 m (100 ft)] quietly and with a minimum of vibration. The sleeve valve discharge would be regulated by an automatic control system based on the difference between water surface elevation in the water supply conduit and the tailrace. The sleeve valve opening would be set using an electric motor driven actuator. The size of the electric motor is estimated to be 1 kW (1.3 hp) or less. Crane access to the sleeve valve would be by mobile crane from the deck of the dam.

(4) Electrical.

The electrical supply to provide for power and control of the drum screen drive and backflush systems, knife gate hydraulic power unit, and sleeve valve actuator would be provided from switchgear LSQ2 in the navigation lock substation room. The loads would be small enough to allow connection to existing spare breakers. Distribution conductors would be in existing cable trays and through rigid steel conduits installed through core drilled penetrations where necessary. Starters would be located adjacent to equipment, and controls would utilize solid state programmable controller technology interfaced with the existing fishway control system.

(5) Conclusion.

This alternative would provide the economic benefit of providing two independent systems that share a common emergency backup source (one of the turbine pumps). There would be increased maintenance costs associated with a new gravity supply system and operation of the additional equipment would increase operator responsibilities.

Using a gravity supply system to provide auxiliary water supply seems attractive because such systems would require minimal electrical requirements and would be separate from the existing pumps. Generally, gravity supply systems are inherently more reliable than pumped systems. However, the requirement for juvenile screening and screen cleaning for the reservoir intake adds complexity and reduces the reliability of the gravity supply system. Maintenance of the reservoir intake screening system would involve the use of divers and would be a time-consuming and expensive process. Also, unless full-flow capacity, as well as backup, is supplied by gravity supply systems, the existing auxiliary water pumps must remain operable.

An energy use comparison shows that the gravity supply system is very inefficient compared to a pumped system. The energy used by the pumping system described in Alternative 3 for a season of operation would be 7,257.6 MW hours [based on three 336 kW (3-450 hp) pumps operated for 24 hours a day for 10 months]. The energy lost by using the 19.8 cms (700 cfs) gravity supply system for a season of operation would be 32,856.8 MW hours, or about four times as much [based on a head loss of 29 m (95 ft) and an 80-percent efficient generator]. Energy recovery generators could be installed in the gravity supply system, but these would also increase the complexity and expense of the system and reduce the reliability.

A detailed life-cycle cost comparison has not been performed for a pumped versus gravity supply system. However, a rough life-cycle cost comparison based on the energy costs associated with the above energy use comparison and the estimated total contract costs for Alternatives 2 and 3 shows that the higher cost of Alternative 3 would be recovered in less than 4 years. The electrical cost used in this comparison was $17.45 per MW hour.

Even though a gravity supply system, as described previously, would provide a backup water supply, this alternative is not recommended for implementation because of the high maintenance and operating costs involved.

c. Alternative 3 (South Shore Supply Conduit Inline Pumping System).

The evaluation of potential pumping schemes includes consideration of the proximity of juvenile fish to the pump intake location. Costs must be included for screens and screen cleaning systems, with all the associated operational and maintenance consequences. These costs and consequences could be minimized or

avoided if the intake could be located where few juveniles are present. A second pumping system configuration would provide such a pump intake location.

(1) General Description.

This alternative would separate the existing auxiliary water supply system into north and south shore auxiliary water supply systems, as proposed in Alternative 1, but in a different way. Inline pumps would be placed in the south shore auxiliary water supply conduit near the south end of the powerhouse in place of the existing regulating tainter gate. A new slide gate would close off the north end of the south shore supply conduit and new openings would be provided into the south shore supply conduit from the tailrace (plates 39, 40, and 41). The north shore entrances would continue to utilize two of the existing hydraulic turbine-driven pumps, with one in reserve. If the new south shore water supply system failed, the third north shore hydraulic turbine pump could be activated for emergency supply. The existing computerized fishway control system would be upgraded so that north and south auxiliary water supply systems would operate independently. Construction of most features required for this alternative would require an outage of the existing auxiliary water supply system for approximately 1 month.

In addition to the improvements listed above, Project Operations would incorporate in their O&M funding plans provisions to maintain or replace components of existing features where hydraulic conditions could be improved. Spare parts inventories for fishway systems' critical components would be increased to improve turnaround times and enhance reliability. Appendix H contains a list of O&M backlog work items. Examples of potential feature improvements are:

- Refurbish entrance gates and operators to reduce leakage.

- Replace floating orifice gate seals.

(2) Inline Pumping System.

(a) New Pumps.

The inline pumping system would consist of up to three large, side by side, axial flow, horizontal, submersible pumps. The pumps would provide a combined flow of 19.8 cms (700 cfs). Either submersible electric or hydraulic motors could drive the pumps. Pump sizes would require medium-voltage electric motors designed for submersible duty. Hydraulic motors would be designed to utilize special double-walled hydraulic lines and would use fish-friendly hydraulic fluid. Another option would utilize deck-mounted electric motors with 90-degree drives and gear cases. Pump and drive configuration options would be investigated further during preparation of plans and specifications, but the cost estimate is based upon three submersible, electric motor-driven, 1 219-mm-diameter (48-in-diameter) pumps.

Initial installation of the pumps could be done with existing bulkheads in place, while the north shore system is operational. The pump installation configuration would be designed for rapid, automated removal from the supply conduit to enable a south shore emergency water supply from the turbine discharge chamber. This removal method could also be used for repair and maintenance of the new pumps. Spare parts, as typically furnished with new equipment, would be provided.

(b) Gates and Bulkheads.

Three automated slide gates and bulkheads would be installed to enable the existing south shore supply conduit to become an independent channel to the south fish ladder system. To isolate the conduit from the north shore system, a large, hydraulically operated slide gate would be placed in the turbine pump discharge chamber at the entrance to the south shore auxiliary water supply conduit. This slide gate could be used during emergency operation as a regulating slide gate, as hydraulic conditions indicate. To provide a water supply source, two 4.28- by 5.18-m (14- by 17-ft) openings would be cut in the downstream side of the south shore supply conduit directly above the exit from the generator 6 scroll case. These openings would be provided with trashracks and slots for hydraulically operated bulkheads. Installation of the main discharge chamber slide gate would require unwatering of the turbine pump discharge chamber and the south shore supply conduit. Providing new openings in the supply conduit would require a temporary bulkhead and possibly some underwater work.

(c) Access.

Crane access to the pump location would be from the tailrace deck by mobile crane. Slide gates would be opened or closed by hydraulic cylinders and would not require a crane except for cylinder removal.

(3) Electrical.

Power is available in the powerhouse to feed the proposed pumping system. A new 5 kV feeder would be installed between a new breaker in the station service SP gear in the powerhouse and the new pump location. Since this pump system would be backed up by a spare turbine pump on the north shore, a dual feeder would not be required. This feeder would be installed in the existing cable tray and in new rigid steel conduit. Breakers and medium-voltage starters would be located either inside the powerhouse or outside near the pumps, as determined during design. The distribution transformer and low-voltage equipment would be installed to provide for local loads (*e.g.,* lighting, controls, and cabinet heaters).

Remote control and annunciation systems would be incorporated for the new pumps, gate, and bulkheads. Remote pump position controls would also be incorporated for emergency pump removal and switchover to the turbine pumps.

(4) Conclusion.

Alternative 3 is recommended for implementation. It would provide a separate water supply to the south shore while preserving the existing configuration for emergency backup. It would utilize existing features with minimal modifications. Compared to Alternative 1, it would provide an intake location where fewer juveniles are likely to be present, and thus would be less hazardous to juvenile fish. The construction cost is slightly lower for this alternative than for Alternative 1. A rough life-cycle cost comparison between Alternatives 2 and 3 shows that the slightly higher cost of Alternative 3 would be recovered in less than 4 years.

d. Alternative 4 (Addition of North Shore Pumps).

The Phase I - Technical Report recommended investigating an alternative that would add two 9.91 cms (350 cfs) pumps on the north shore, while continuing to feed water to the south shore through the south shore supply conduit. Considering the new criteria, the alternatives where the north shore and south shore would be divided into two separate auxiliary water supply systems are more effective alternatives, avoiding the increased losses created by the increased flows (required by the new criteria) in the south shore conduit. Therefore, this alternative was not considered further.

e. Alternative 5 (Enhanced Preventive Maintenance Program).

The existing north shore turbine pumps are all required to run full-time to attempt to meet the FPP criteria. Therefore, this alternative alone could not provide emergency auxiliary water supply for the Lower Monumental fishways and is not considered a viable alternative by itself.

f. Alternative 6 (Barge Mounted Pumps Shared with Ice Harbor).

As discussed in the section on Ice Harbor, this alternative was not further evaluated due to the difficulty and safety issues involved in tying off a barge along the Ice Harbor fish ladder training wall. There would be similar problems at Lower Monumental. Since it would not be a workable alternative at Ice Harbor, the advantages of sharing the barge and its water supply features between projects would be lost. Therefore, this alternative was not investigated as a viable alternative for Lower Monumental.

3.05 SUMMARY, ESTIMATED COSTS, RECOMMENDATIONS, AND DESIGN AND CONSTRUCTION SCHEDULE.

a. Summary.

Six alternatives were discussed for providing an emergency auxiliary water supply at Lower Monumental. Three would involve separating the auxiliary water supply system into a north shore system and a south shore system and providing a new auxiliary water supply for the south shore fishway. Alternative 1 would provide a pumping plant on the south shore with screened intake. Alternative 2 would provide a gravity supply system on the south shore. Alternative 3 would provide an inline pumping scheme utilizing the existing south shore supply conduit with a water source near the generator unit 6 outlet. The north shore system would have one spare turbine pump to provide emergency auxiliary water for both the north shore and south shore systems. Alternative 4 would involve adding new pumps to the north shore. Alternative 5 would rely on an enhanced preventative maintenance program. Alternative 6 would use barge mounted pumps shared with Ice Harbor.

b. Estimated Costs.

The estimated construction costs for alternatives 1, 2, and 3 are shown in table 3-1. The construction costs for alternatives 4, 5, and 6 were not estimated. Table 3-1 does not include costs for the recommended O&M funded activities. Implementation of any of the alternatives would require additional funding for E&D and S&A. The O&M and spare parts costs would be determined by Project Operations. The Total Contract Cost Summaries and the Project Indirect Summaries for alternatives 1, 2, and 3 are provided in appendix F. The estimates were prepared using the MCACES software.

A 30-percent contingency is appropriate to identify the uncertainty associated with the level of design provided for the construction estimate for the recommended alternative. The Total Contract Cost Estimate (developed at the October 1, 1999, price level) is escalated for inflation through the midpoint of construction based on construction beginning October 2000, and ending September 2002. Midpoint of construction is the first quarter FY 02. The Contract Cost Estimate supports the scope and construction schedule of this Phase II - Technical Report. Total construction costs, escalated to the midpoint of construction, are estimated to be $6,267,000 for the recommended alternative. The total fully-funded costs for the recommended alternative are estimated to be $8,681,000.

Table 3-1: Estimated Construction Costs

Alternative	Estimated Construction Cost
1 - South Shore Pumping System	$6,020,728
2 - Gravity Supply System	$4,827,600
3 - Inline Pumping System	$5,802,928
4 - Addition of North Shore Pumps	N/A
5 - Enhanced Preventative Maintenance	N/A
6 - Barge Mounted Pumps	N/A

c. Recommendation.

Alternative 3 (South Shore Supply Conduit Inline Pumping System) is recommended for implementation. Operations should inspect all pertinent existing systems and develop any required maintenance schedules or spare parts inventory requirements for inclusion in O&M funding plans. This would include plans for replacement, refurbishment, or rebuilding of existing equipment to return systems to the original condition.

d. Design and Construction Schedule.

The schedule for design and construction is dependent on obtaining funding. Considering the current budget cycle, it is anticipated that design funds would first become available in FY 00. Design and award of a construction contract would be completed by the end of FY 00. Construction is anticipated to be complete by the end of FY 02.

SECTION 4 – ENVIRONMENTAL REQUIREMENTS

4.01. GENERAL.

Construction, installation, and operation of emergency auxiliary water supply systems for the existing auxiliary water supply systems at Ice Harbor and Lower Monumental will require coordination with appropriate agencies, as well as compliance with applicable environmental laws and regulations. These requirements include the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Fish and Wildlife Coordination Act (FWCA), and various cultural resources and water quality laws. Coordination and compliance work will begin when the recommended alternative is defined. Appendix I contains copies of correspondence between NMFS and the Walla Walla District Corps of Engineers that was written during preparation of this Phase II - Technical Report.

a. The NEPA Requirements.

All options outlined within this Phase II - Technical Report are consistent with a category of activities that carry out authorized project purposes at completed U.S. Army Corps of Engineers projects [refer to Engineer Regulation 200-2-2]. These activities have been determined to be categorically excluded from NEPA documentation. Appropriate documentation addressing NEPA laws and regulations will be drafted to warrant a categorical exclusion for the alternatives selected, based on project authorization for Ice Harbor and Lower Monumental to provide upstream passage for adult salmon.

b. The ESA Requirements.

(1) Anadromous Fish Stocks.

Federal agencies are required to consult with NMFS for actions they intend to implement that may jeopardize the existence of ESA-listed fish stocks. The Snake River sockeye salmon (listed as endangered on December 20, 1991) and the Snake River spring/summer Chinook and fall Chinook salmon (upgraded from threatened to endangered by the proposed listing on December 28, 1994) pass around Ice Harbor and Lower Monumental during their upstream migration as adults and their downstream outmigration as juveniles. Because the construction and operation of the auxiliary water supply systems at Ice Harbor and Lower Monumental have the potential to affect listed salmon stocks, a formal or informal consultation with NMFS on these actions will likely be necessary.

(2) Terrestrial Wildlife and Resident Fish.

Federal agencies are also required to consult with the U.S. Fish and Wildlife Service (USFWS) for actions they intend to implement that may jeopardize the

existence of ESA-listed freshwater fish stocks and terrestrial species. Although the endangered peregrine falcon, bald eagle, and bull trout may use the habitat around Ice Harbor and Lower Monumental, it is anticipated that no impact to these species will occur. Therefore, consultation with USFWS will not be necessary for the species of concern, with the possible exception of bull trout.

c. The FWCA Requirements.

Coordination with USFWS will occur to ensure compliance with FWCA.

d. Clean Water Act Requirements.

Emergency auxiliary water supply alternatives that have any in-water discharge of fill material will require compliance with sections 404 and 401 of the *Clean Water Act*, Public Law 95-217, 1977. Any modification of water quality standards and/or in-water permits will be required from the State of Washington.

e. Cultural Resources Requirements.

Coordination for cultural and historic properties must be in compliance with sections 106 and 110 of the *National Historic Preservation Act*, Public Law 89-665, 1996. All activities resulting from the implementation of these options will occur in previously disturbed areas and to facilities less than 50 years in age. Therefore, it is unlikely that these actions will result in an adverse affect to cultural resources. A request will be sent to the Washington State Historic Preservation Officer for a concurrence of no effect.

4.02. RECOMMENDED ALTERNATIVES.

Formal consultation will be initiated with NMFS to seek their concurrence that the operation of the adult fishways and auxiliary water supply pump failures, while the systems are out of service during their overhaul, is unlikely to adversely affect individuals of listed salmon stocks.

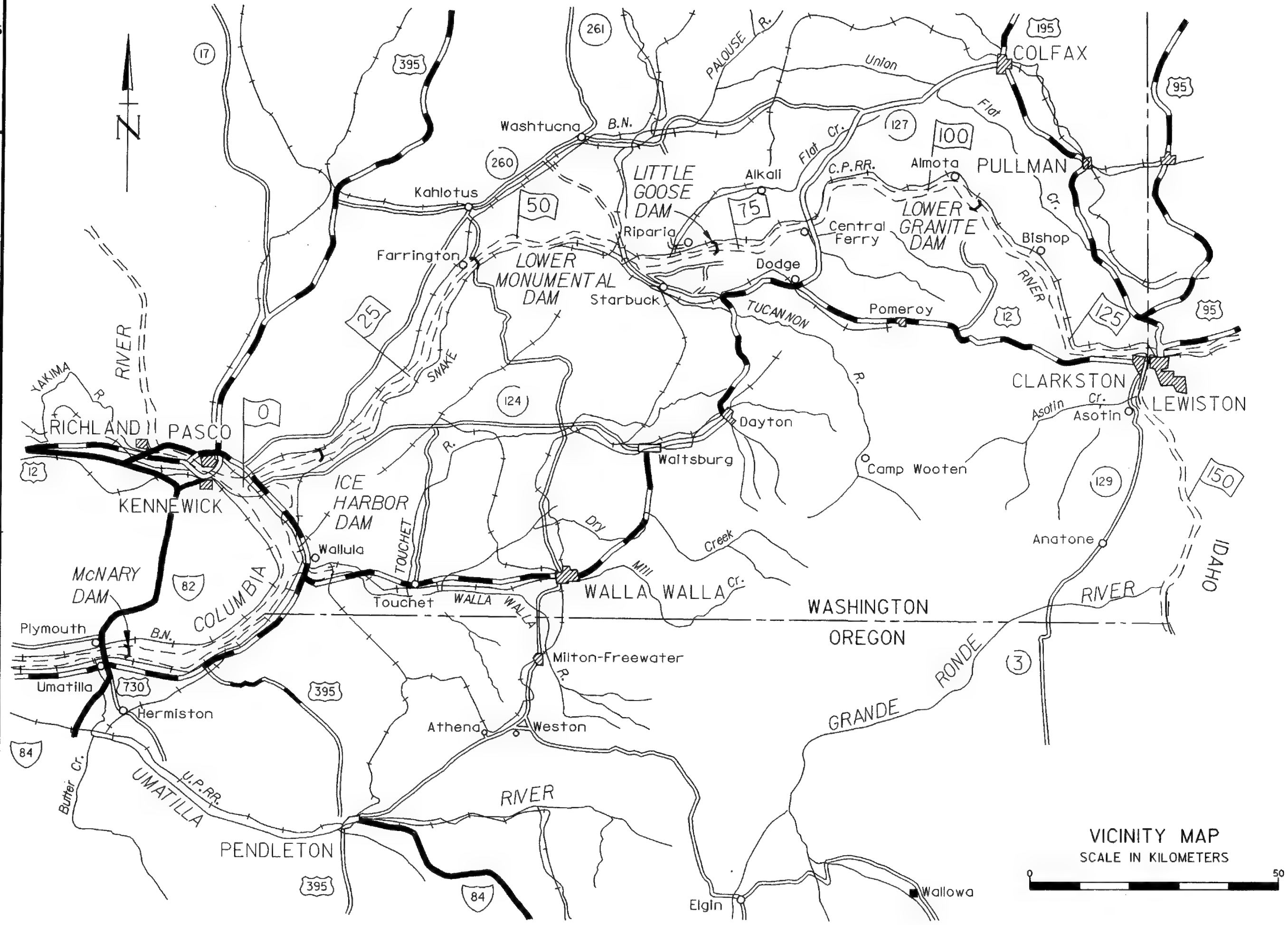
An ESA consultation for the operation of the systems following the period of modifications will not be required, because they will operate in much the same manner as described in the FPP for the year of implementation. The NMFS has previously been consulted, and they have commented on the operation of fish pumps identified in the FPP in the *Supplemental Biological Opinion, Operation of the Federal Snake River Power System*, 1998. Recommended alternatives will be coordinated with Federal, State, and Tribal fishery agencies through the U.S. Army Corps of Engineers' Fish Facilities Design Review Workgroup process resulting in biological effect and benefit analysis evaluation to be included in the NMFS' Biological Opinion, Operation of the Federal Snake River Power System, 2000.

GLOSSARY

GLOSSARY FOR MATHEMATICAL TERMS

cfs	-	cubic feet per second
cm	-	centimeter
cms	-	cubic meters per second
fps	-	feet per second
hp	-	horsepower
kg	-	kilograms
km/h	-	kilometers per hour
kV	-	kilovolt (1000 volts)
kVA	-	kilovoltampere
kW	-	kilowatt (1000 watts)
L/s	-	liters per second
m	-	meters
mm	-	millimeters
mps	-	meters per second
msl	-	mean sea level
MW	-	megawatt (1,000,000 watts)
O.C.	-	on center
Pa	-	pascal
V	-	volt

PLATES



US Army Corps of Engineers
Walla Walla District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

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Drawn by: ROGERS
Checked by:
Supervised by:
Chief, MECH. DES. SEC.

Date: XXX
Scale: AS SHOWN
Inv. No.: XX-B-XX
File No.: XXX

Submitted by:
Chief, Design Branch
Recommended by:
Chief, Engineering Division

CONT. NO.

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
SNAKE RIVER PROJECTS
VICINITY MAP

Plate number: 1

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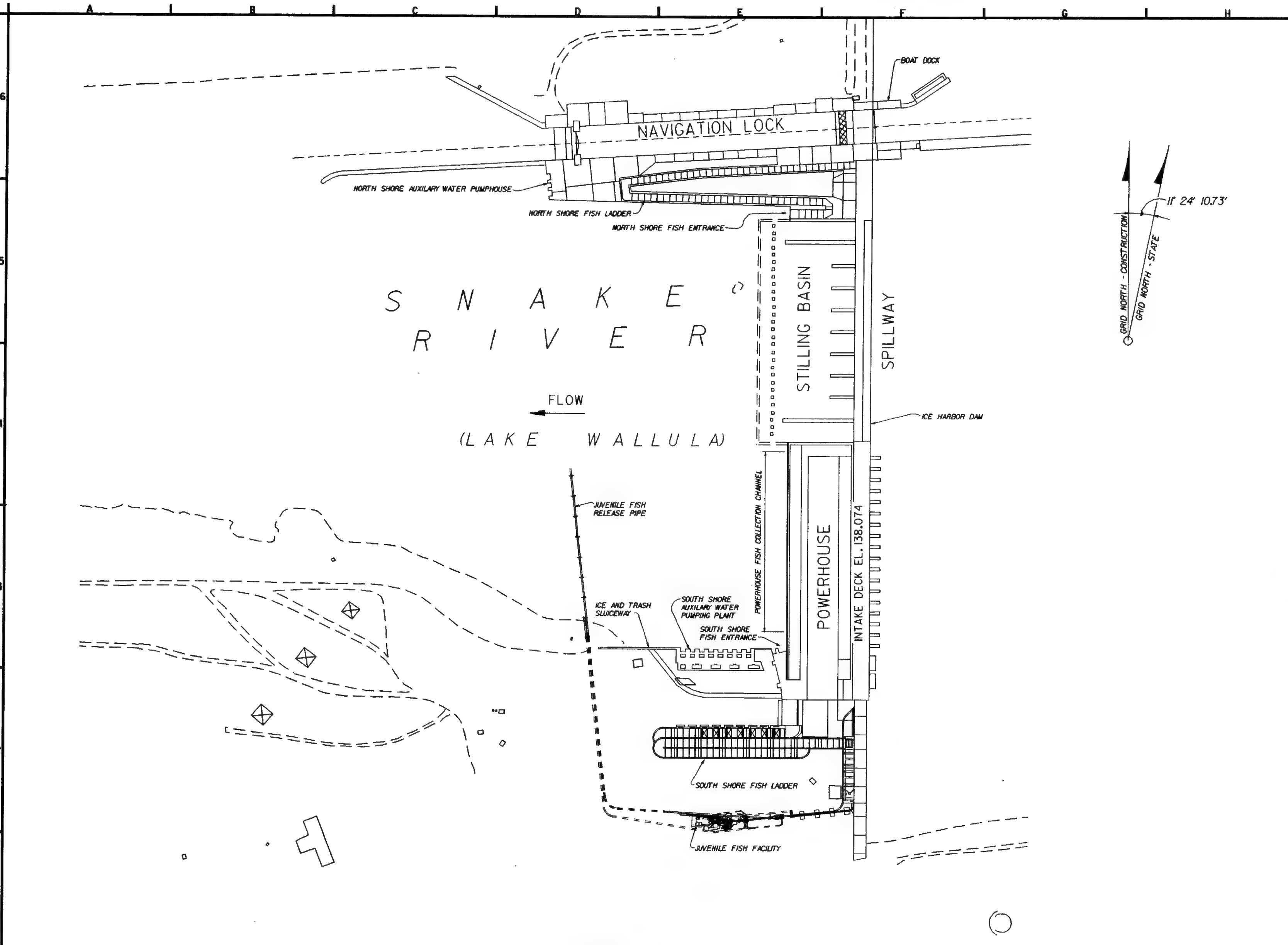

ICE HARBOR DAM SITE PLAN

NOTE:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN METERS.

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LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
SITE PLAN

Plate number: 2

PEN TABLE ATTACHED: NO
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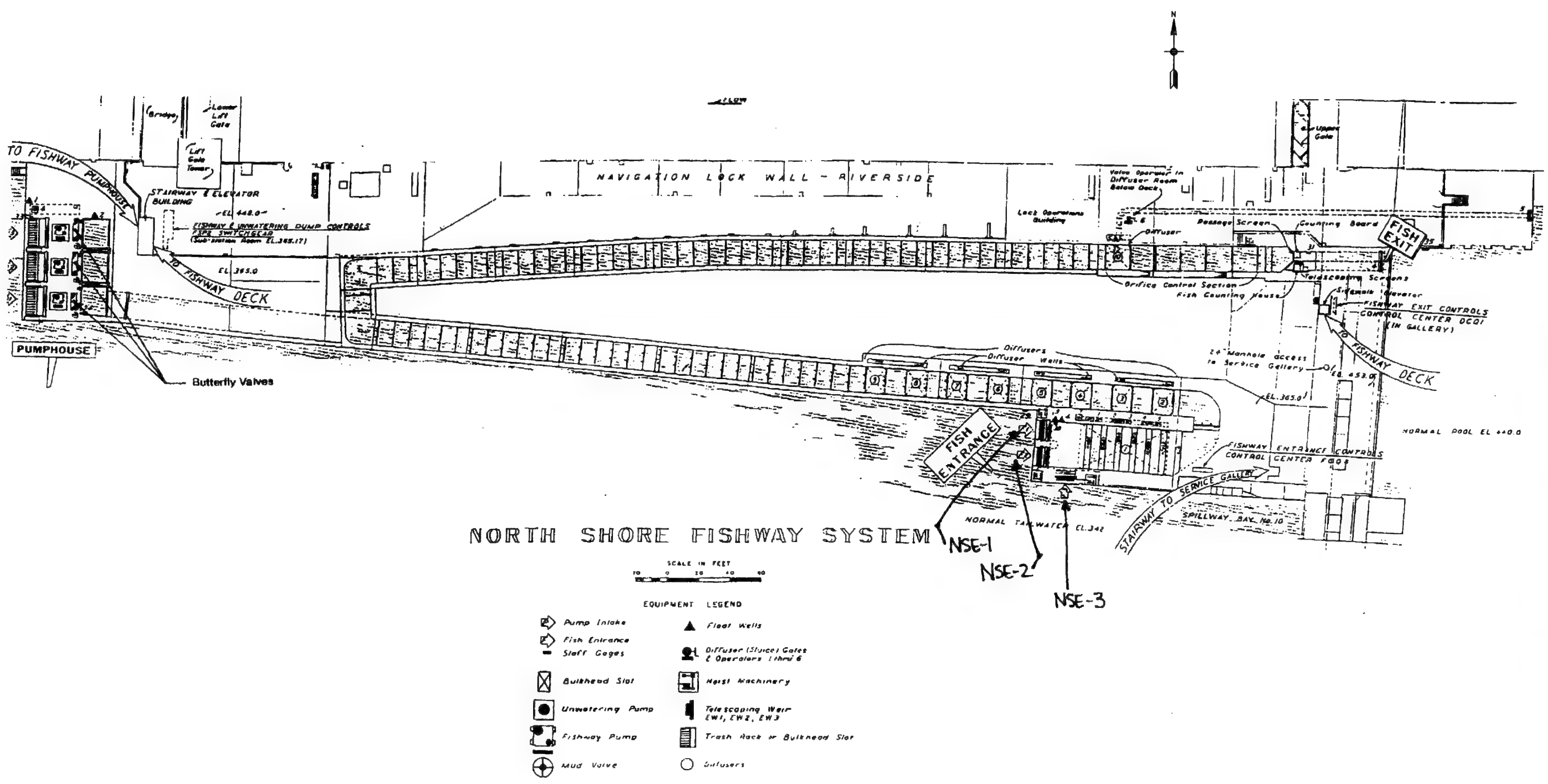

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LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
EXISTING
NORTH SHORE ADULT FISHWAY SYSTEM

Plate number: 3

CONT. NO.

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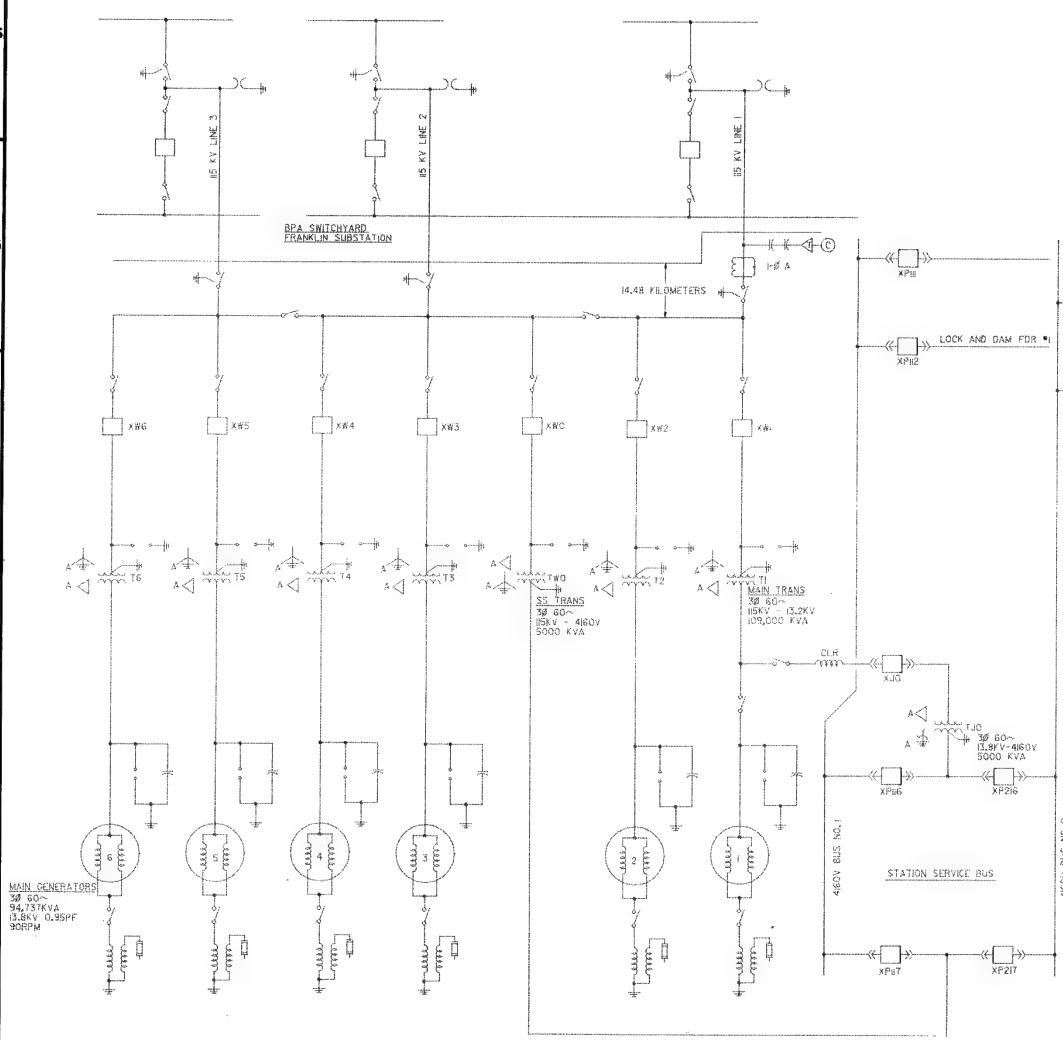
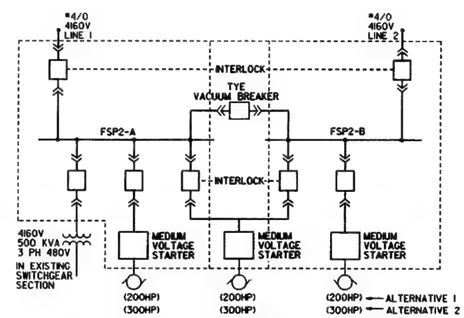


ICE HARBOR EXISTING PARTIAL ONE-LINE



NORTH LADDER FISHPUMP ONE-LINE REVISION

NEW 4160V SWITCHBOARD CONFIGURATION

THIS BUS CONFIGURATION WILL ALLOW FOR SOME REDUNDANCY IN THE EVENT OF FAILURES WITHIN SWITCHGEAR

US Army Corps of Engineers
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LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBERS 1 & 2
POWER ONE-LINE DIAGRAM

Plate number: 4

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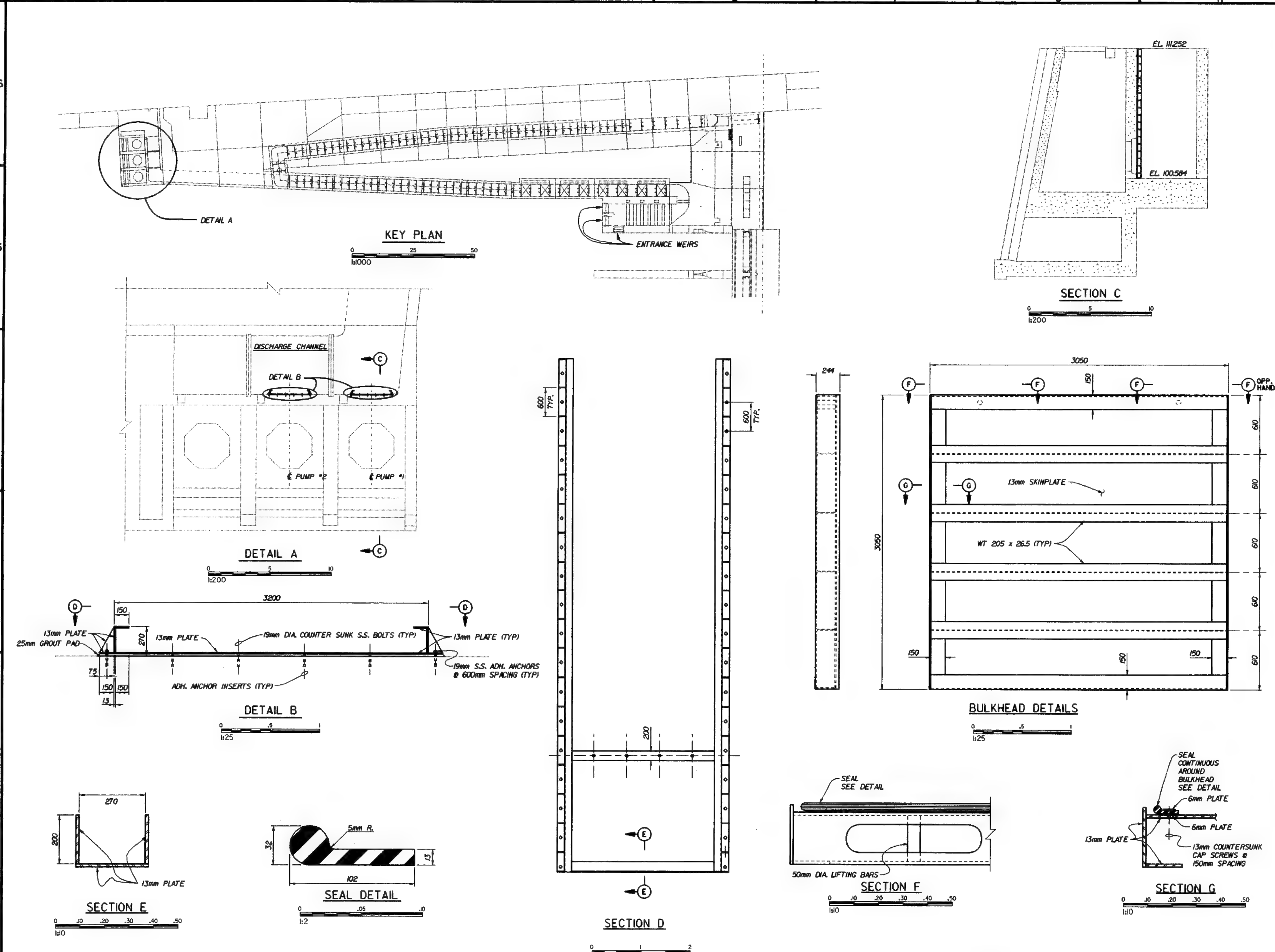

NEW
EXISTING

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.

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CADD FILENAME:L:\usr7\cad\eaw\iceaws4.dgn PLOT TIME:20-SEP-1999 09:09

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVES
PUMP ISOLATION
BULKHEADS
PLAN, SECTIONS AND DETAILS

Plate number: 5

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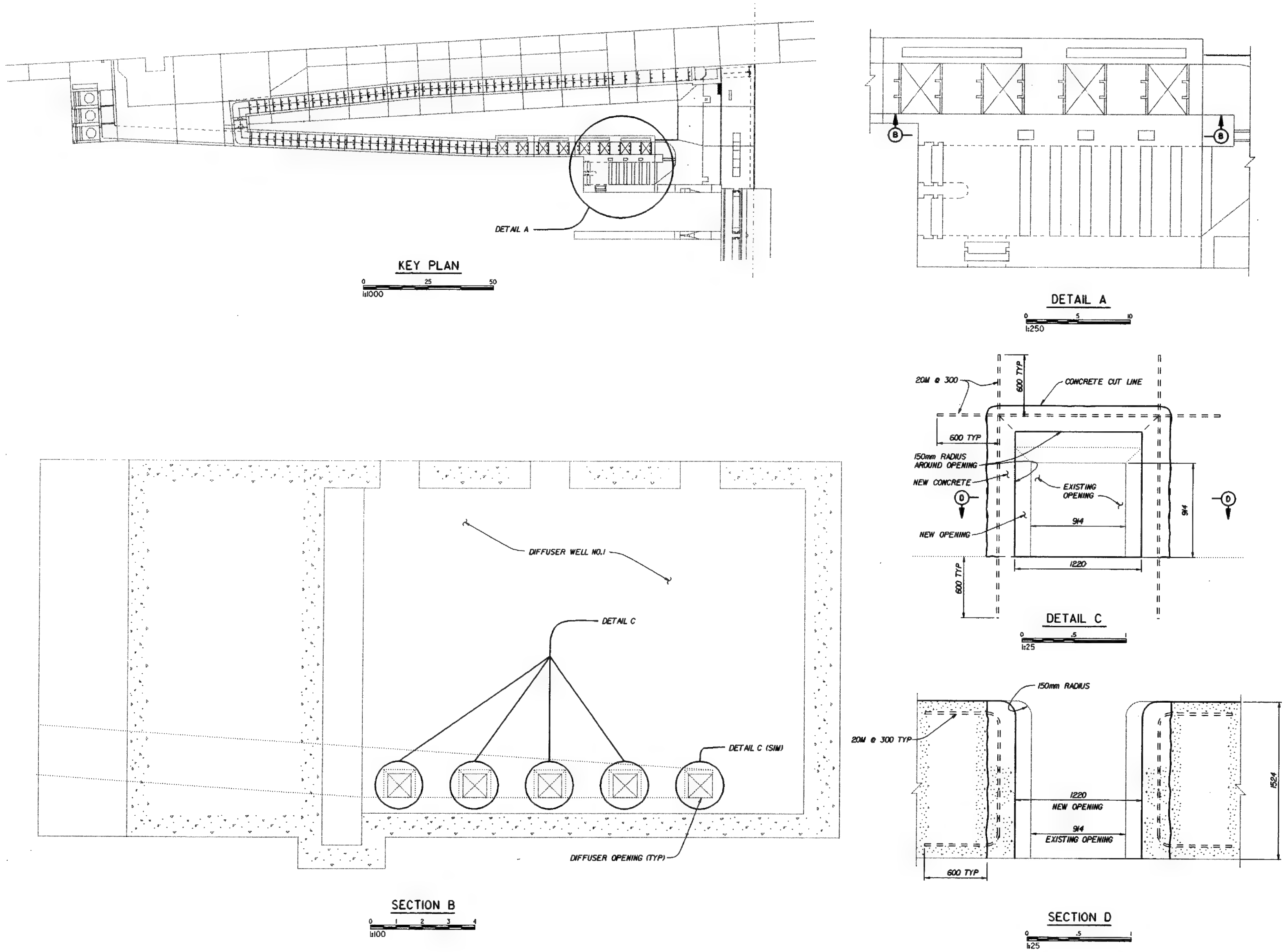

NEW
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NOTES:
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SHEET MAIN SCALE: 1:100

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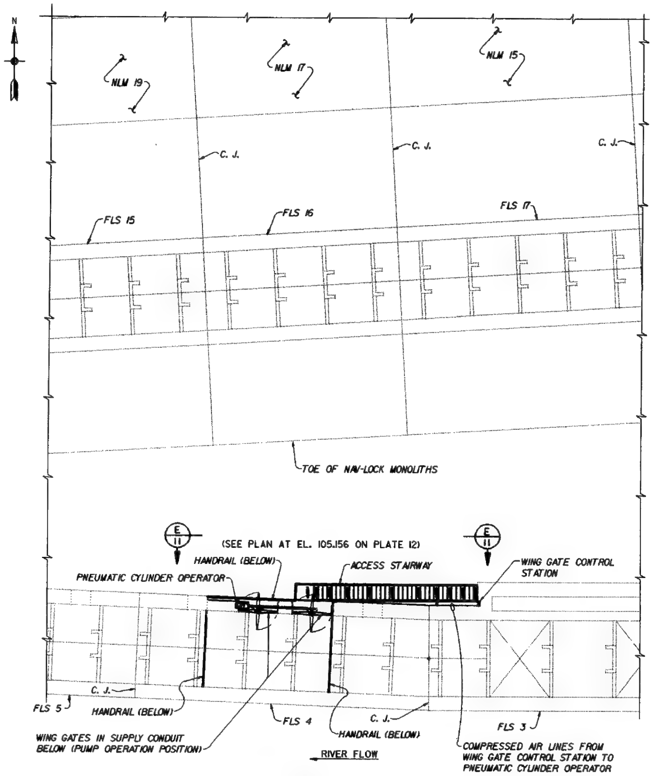
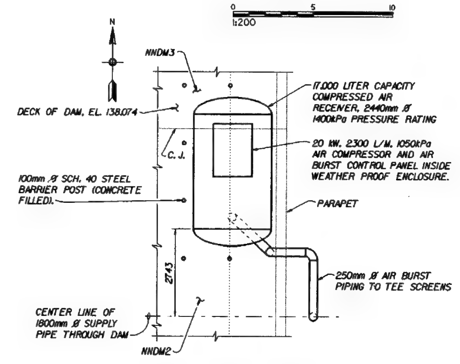
LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVES
DIFFUSER MODIFICATION
PLAN, SECTIONS AND DETAILS

Plate number: 6



FISH LADDER PARTIAL PLAN

1:200



AIR BURST RECEIVER PARTIAL PLAN

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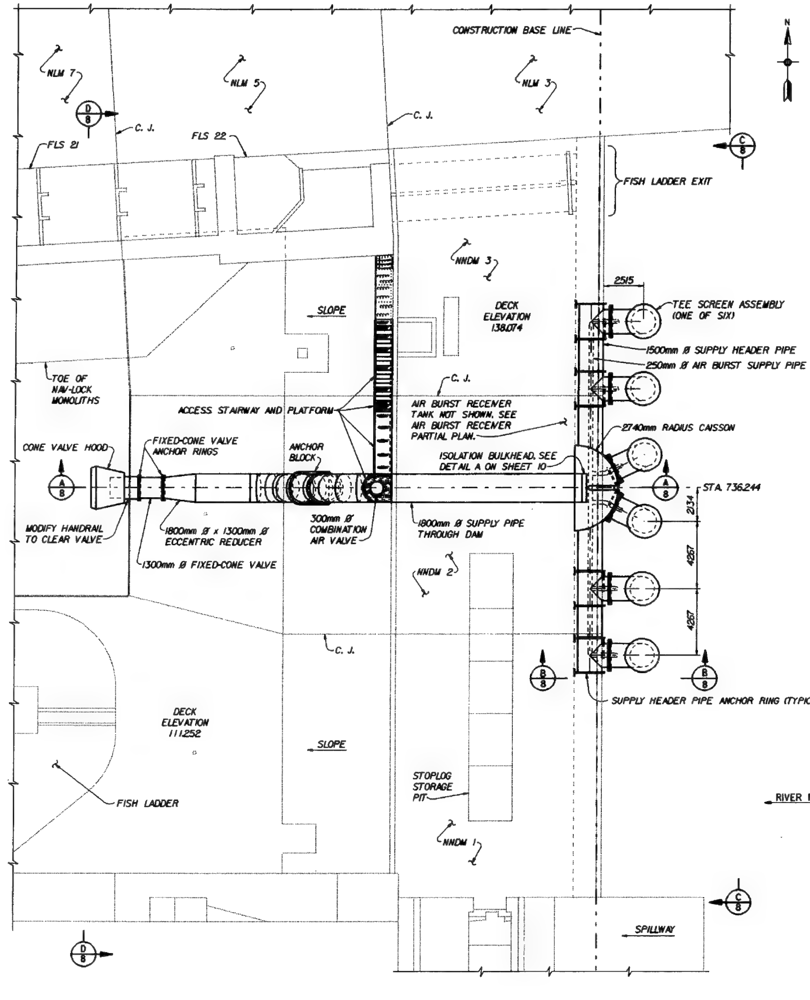

NORTH NON-OVERFLOW DAM PARTIAL PLAN

1:200

LEGEND

C. J. = CONTRACTION JOINT
FLSXX = FISH LADDER SECTION NUMBER
NLMXX = NAVIGATION LOCK MONOLITH NUMBER
NNDMXX = NORTH NON-OVERFLOW DAM MONOLITH NUMBER
TYPICAL REPRESENTATION OF NEW MATERIALS
TYPICAL REPRESENTATION OF EXISTING MATERIALS

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. TEE SCREEN INTAKE SYSTEM MAY BE USED WITH EITHER FIXED-CONE VALVE DISCHARGE AS DEPICTED ON THIS PLATE OR WITH INLINE SLEEVE VALVE DISCHARGE AS DEPICTED ON PLATE 14.

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LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
TEE SCREEN INTAKE SYSTEM AND FIXED
CONE VALVE DISCHARGE SUB-ALTERNATIVES
PARTIAL PLANS

Plate number: 7

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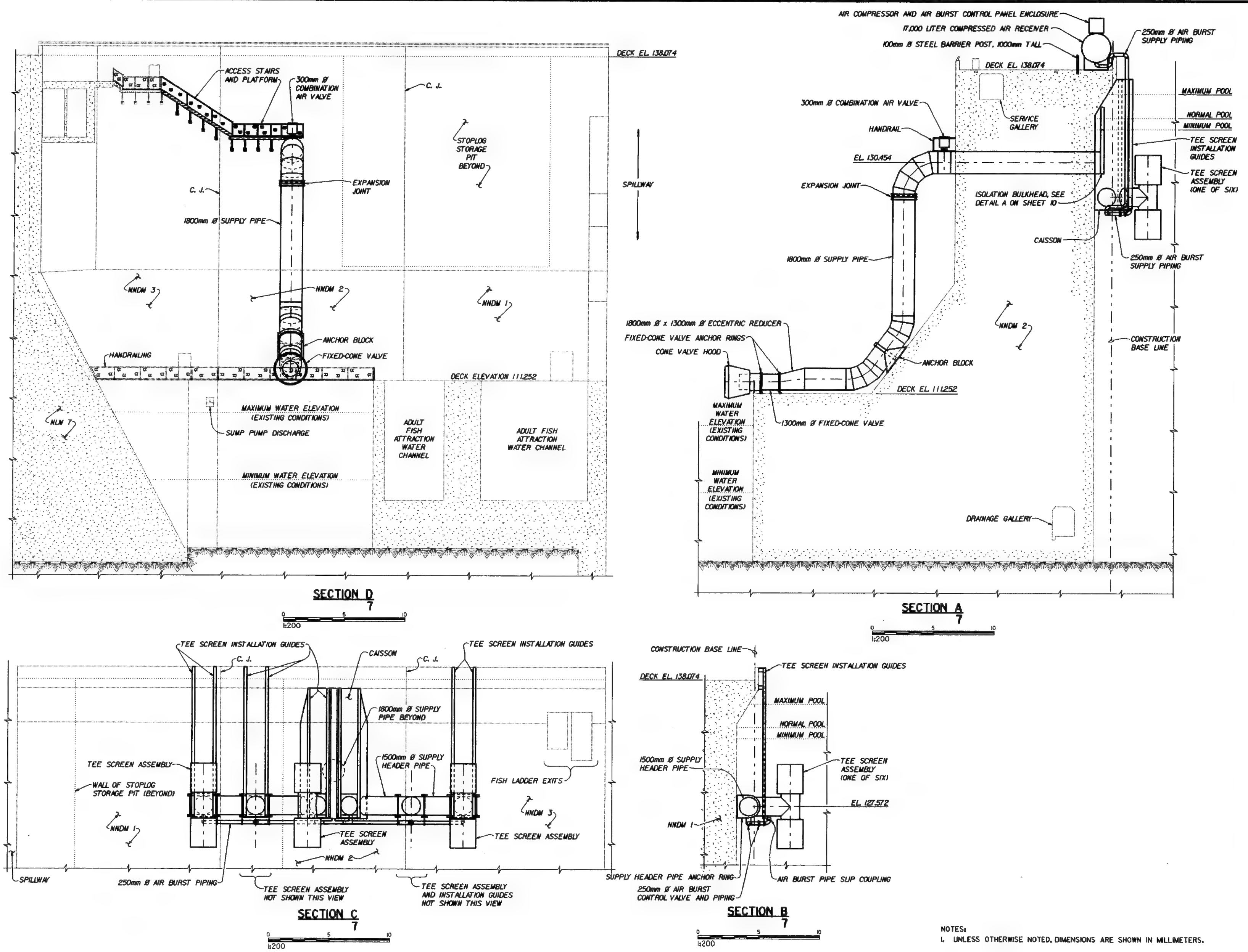

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. SEE PLATE 7 FOR LEGEND.

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LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
TEE SCREEN INTAKE SYSTEM AND FIXED
CONE VALVE DISCHARGE SUB-ALTERNATIVES
SECTIONS AND ELEVATIONS I

Plate number: 8

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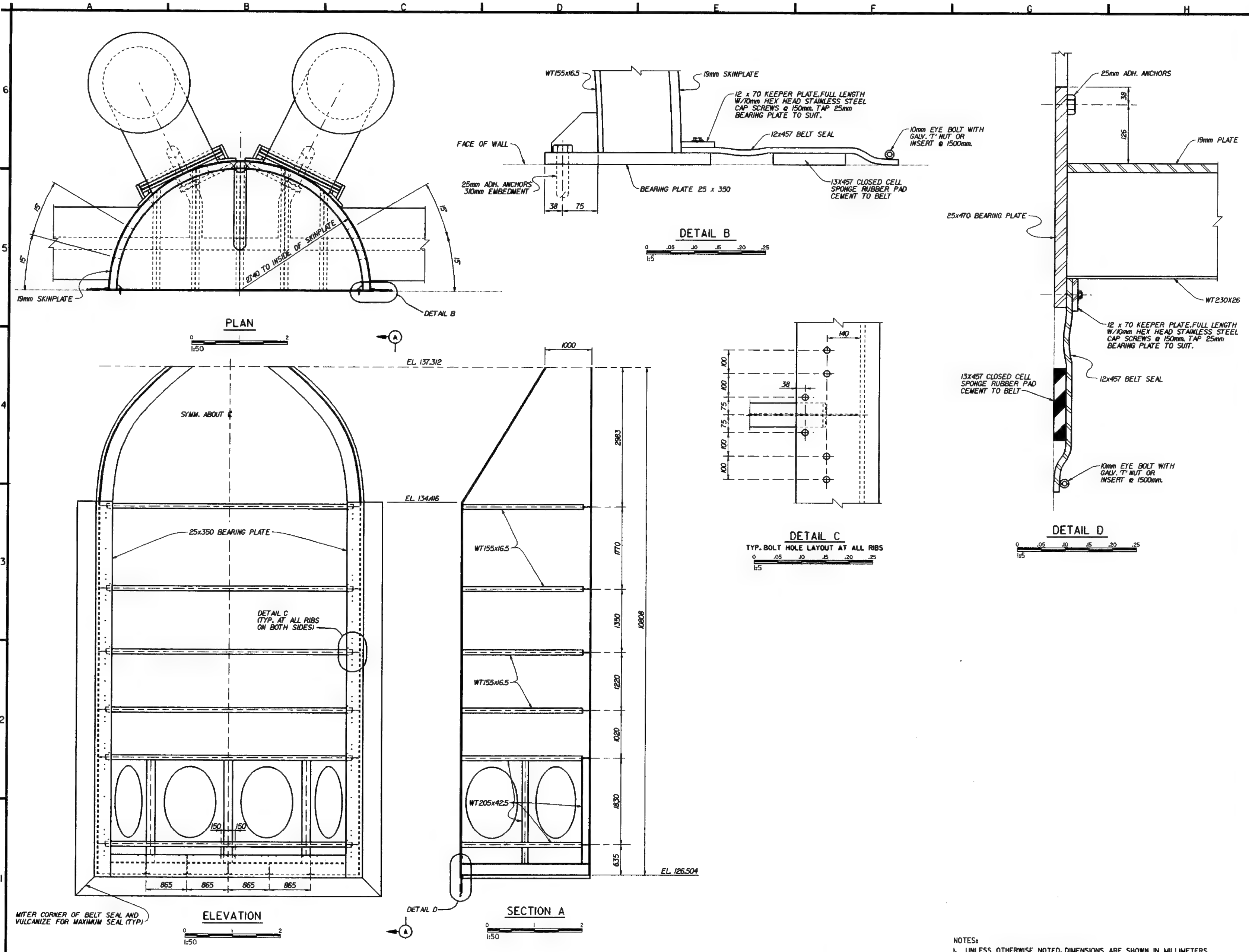
SHEET MAIN SCALE: X



NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.

US Army Corps of Engineers
Walla Walla District

Revision	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.

MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

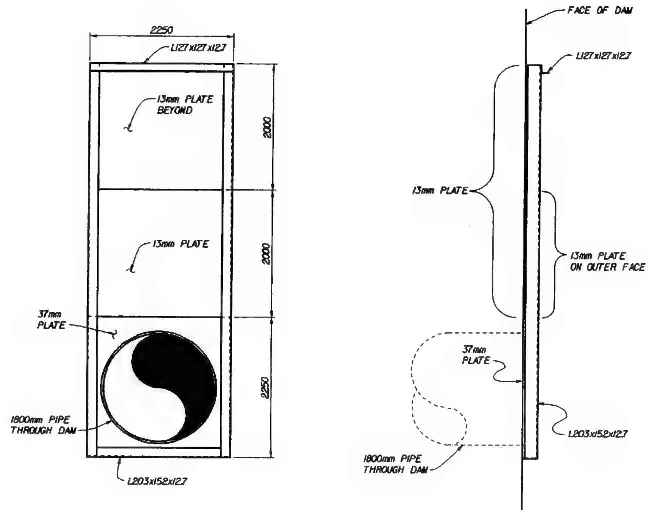
Designed by: LOWELAND	Date: XXX
Drawn by: SHENEFIELD	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, STRUCT. SEC.	

CADD FILENAME:L:\usr7\cad\eaw\iceaws8.dgn PLOT TIME:20-SEP-1999 09:08

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
CAISSON
DETAILS
PLANS AND ELEVATIONS

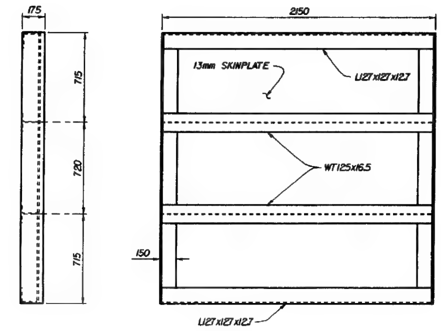
Plate number: 9

PEN TABLE ATTACHED: ICEAWS8.HAF
REFERENCE FILES: EAW.BLK.TB
SHEET MAIN SCALE: 1:100



DETAIL A - ISOLATION BULKHEAD GUIDE
7,8,14,15,16,17

1:50



ISOLATION BULKHEAD

1:25

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.

US Army Corps of Engineers
Walla Walla District

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.
MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

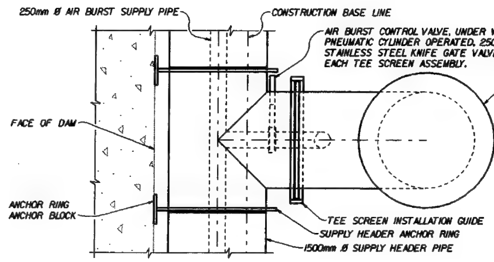
Designed by: LOWELAND — Date: XXX
Drawn by: SHENEFIELD — Scale: AS SHOWN
Checked by: — Inv. No.: XX-8-XX
Supervised by: — File No.: XXX
Chief, STRUCT. SEC.

CADD FILENAME:L:\usr7\cad\eaw\iceaw10.dgn PLOT TIME:20-SEP-1999 09:07

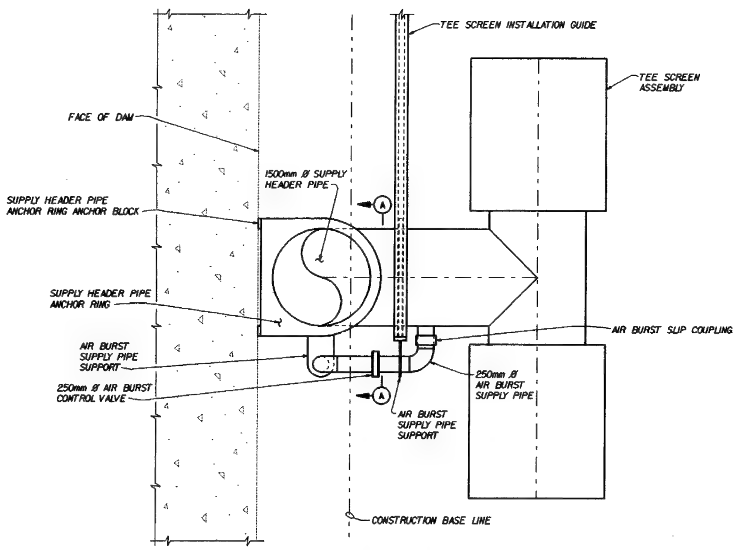
LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
ISOLATION BULKHEAD AND GUIDE

Plate number: 10

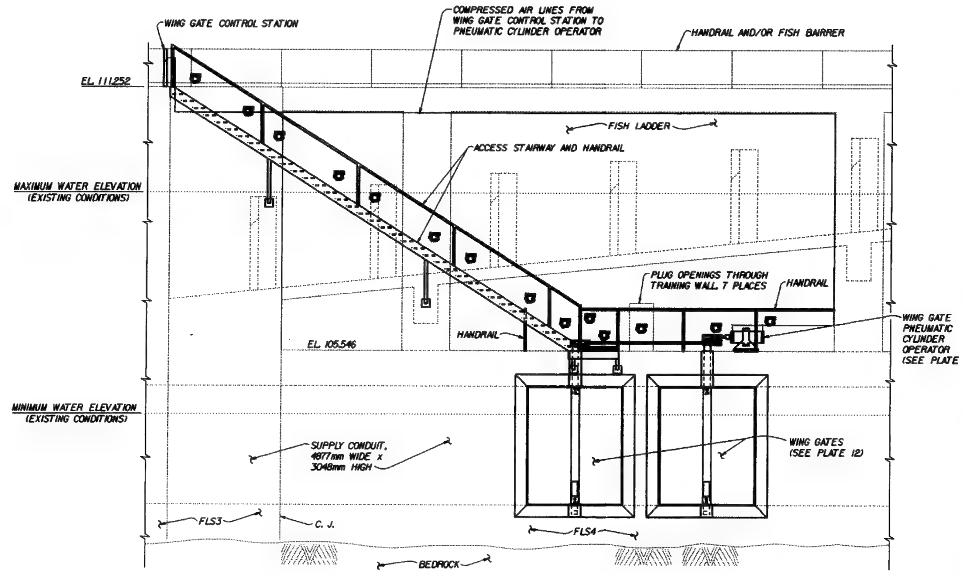
PEN TABLE ATTACHED: NOPE
REFERENCE FILES: EAW,BLK,TB
SHEET MAIN SCALE: 1:100



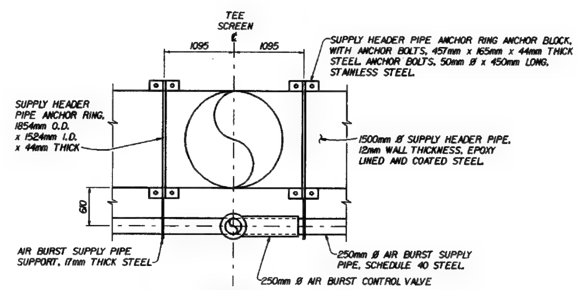
TEE SCREEN PLAN
1:50



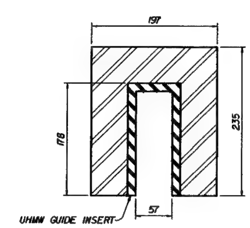
TEE SCREEN SIDE ELEVATION
1:50



ELEVATION E / 7
1:80



SECTION A
1:50



INSTALLATION GUIDE SECTION
1:5

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. ALL FERROUS SURFACES, EXCEPT STAINLESS STEEL, TO RECEIVE EPOXY PAINT SYSTEM.
3. SEE PLATE 7 FOR LEGEND.

US Army Corps of Engineers
Walla Walla District

Symbol	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.
MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

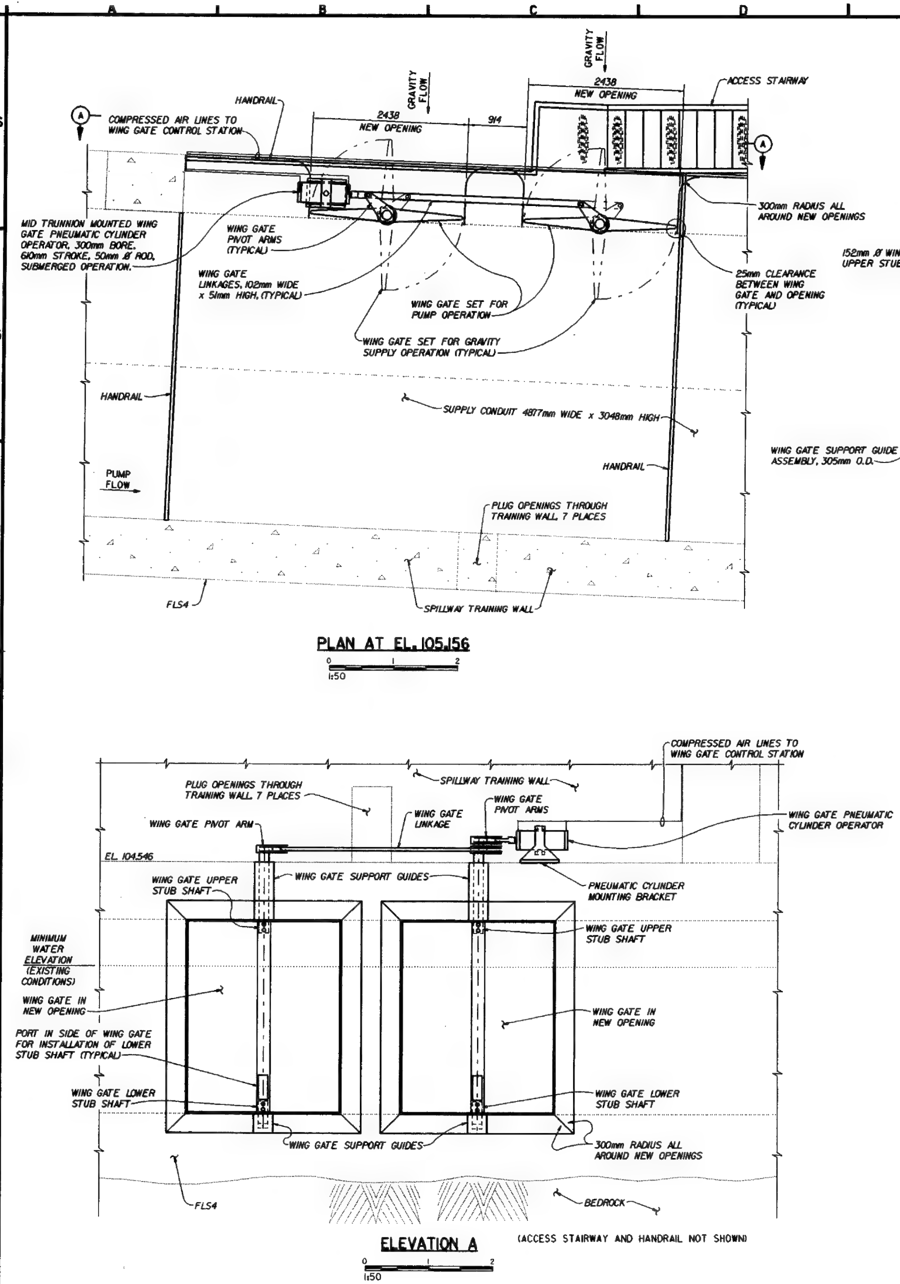
Designed by: K. RENSHAW PE	Date: XXX
Drawn by: K. RENSHAW PE	Scale: AS SHOWN
Checked by:	Inv. No.: XX-8-XX
Supervised by:	File No.: XXX
Chief, MECH. SEC.	

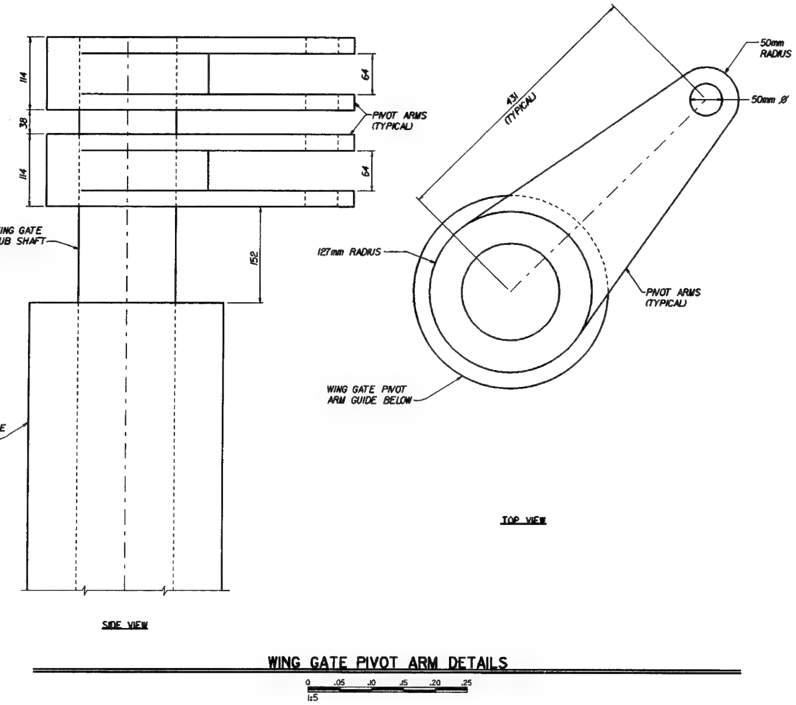
CADD FILENAME: L:\usr7\cad\eaw\iceawmi3.dgn PLOT TIME: 20-SEP-1999 09:07

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
TEE SCREEN INTAKE SYSTEM AND FIXED CONE VALVE DISCHARGE SUB-ALTERNATIVES
SECTIONS AND ELEVATIONS II

Plate number: 11

PEN TABLE ATTACHED: ICEAWMI3.HAF
REFERENCE FILES: EAW.BLK
SHEET MAIN SCALE: X





NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. SEE PLATE 7 FOR LEGEND.
3. ALL FERROUS SURFACES, EXCEPT STAINLESS STEEL, TO RECIEVE EPOXY PAINT SYSTEM.

US Army Corps of Engineers
Walla Walla District

Symbol	Description	Date	Appr.

Submitted by:
Chief, Design Branch
Recommended by: Date
Chief, Engineering Division Date
CONT. NO.

Designed by: K. RENSHAW; PE
Date: XXX
Drawn by: K. RENSHAW; PE
Scale: AS SHOWN
Checked by:
Inv. No.: XX-B-XX
Supervised by:
Chief, MECH. SEC.
File No.: XXX

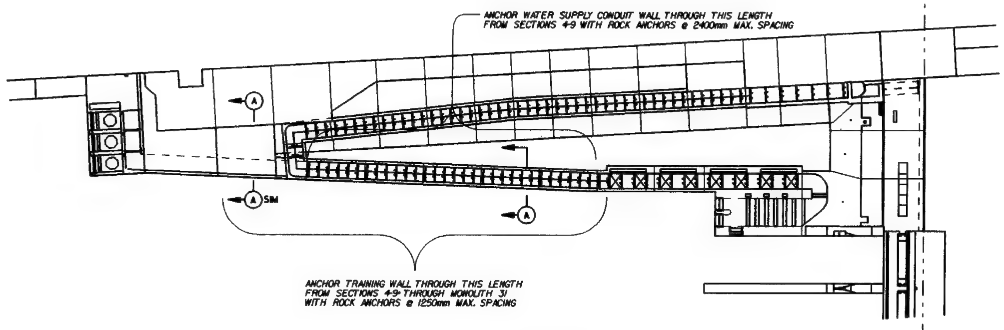
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
TEE SCREEN INTAKE SYSTEM AND FIXED
CONE VALVE DISCHARGE SUB-ALTERNATIVES
SECTIONS AND ELEVATIONS III

Plate number: 12

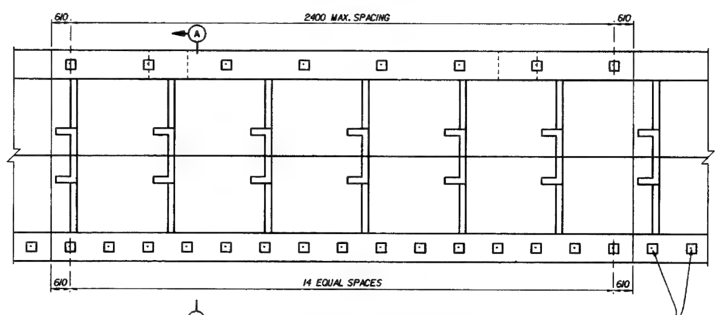
MICROSTATION SE
CADD FILENAME: L:\usr7\cad\eaw\iceawnl4.dgn PLOT TIME: 20-SEP-1999 09:06

PEN TABLE ATTACHED: ICEAWM14.HAF
SHEET MAIN SCALE: X
REFERENCE FILES: EAW.BLK



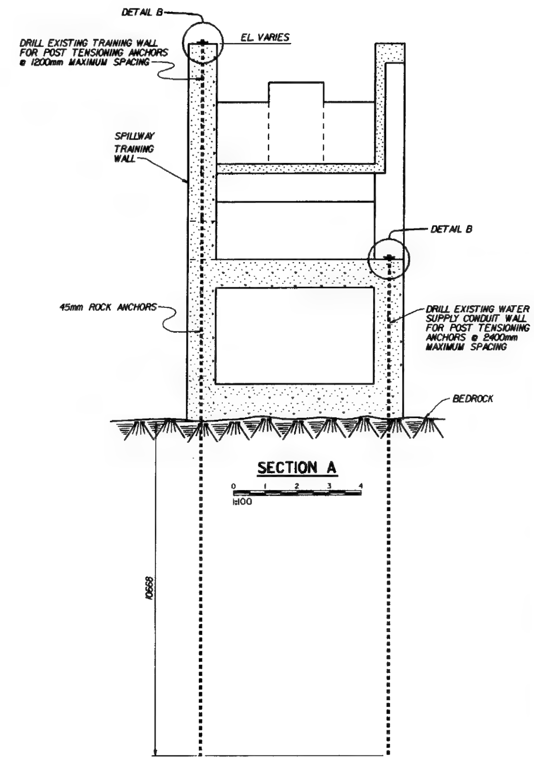
KEY PLAN

0 25 50
1:1000



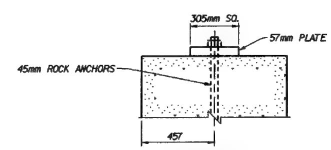
TYPICAL FISHLADDER SECTION

0 1 2 3 4
1:100



SECTION A

0 1 2 3 4
1:100



DETAIL B

NOT TO SCALE

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.

US Army Corps of Engineers
Walla Walla District

Symbol	Description	Date	Appr.

Submitted by:
Chief, Design Branch Date
Recommended by:
Chief, Engineering Division Date
CONT. NO.
MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

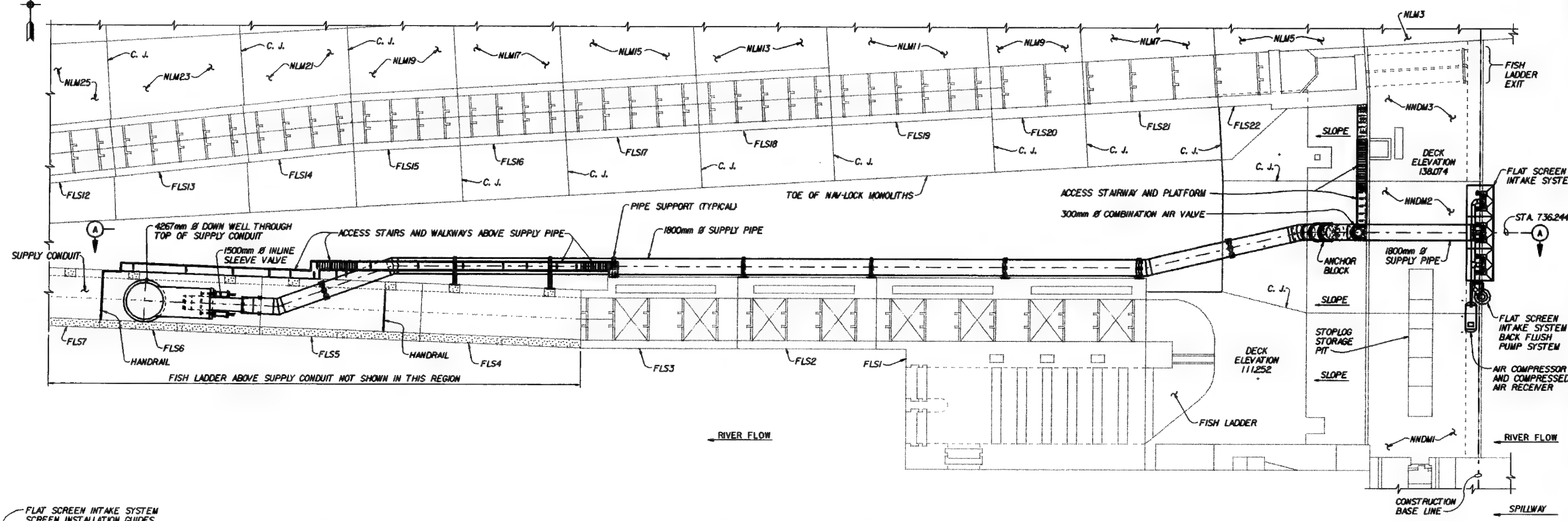
Designed by: LOWELAND	Date: XXX
Drawn by: SHENEFIELD	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, ---- SEC.	

CADD FILENAME:L:\usr7\cad\eaw\iceaws7.dgn PLOT TIME:20-SEP-1999 09:05

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
TRAINING WALL
REINFORCEMENT
PLAN, SECTIONS AND DETAILS

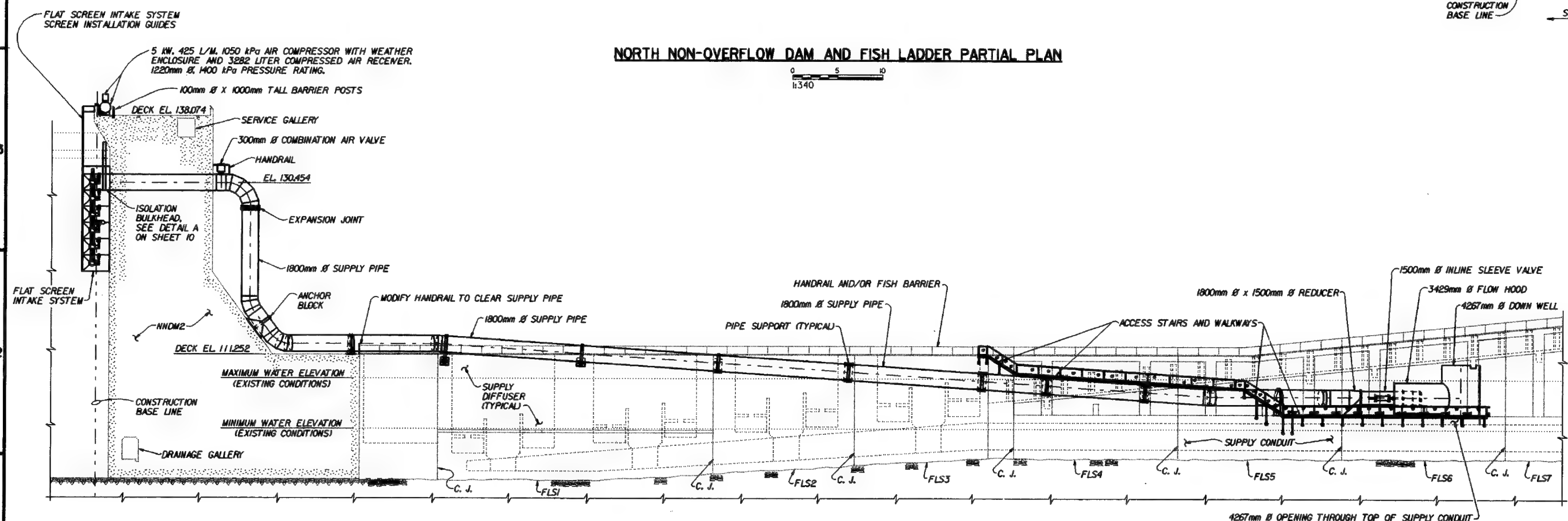
Plate number: 13

PEN TABLE ATTACHED: NO
SHEET MAIN SCALE: 100:1
REFERENCE FILES: EAW.BLK,TB



NORTH NON-OVERFLOW DAM AND FISH LADDER PARTIAL PLAN

0 5 10
1:340



ELEVATION A

0 5 10
1:340

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. SEE PLATE 7 FOR LEGEND.
3. FLAT SCREEN INTAKE SYSTEM MAY BE USED WITH EITHER INLINE SLEEVE VALVE DISCHARGE AS DEPICTED ON THIS PLATE OR WITH FIXED-CONE VALVE DISCHARGE AS DEPICTED ON PLATE 7.
4. SEE PLATE 15 FOR ADDITIONAL FLAT SCREEN INTAKE SYSTEM AND INLINE SLEEVE VALVE INSTALLATION DETAILS.

US Army Corps of Engineers
Walla Walla District

Submitted by:
Chief, Design Branch Date
Recommended by:
Chief, Engineering Division Date
CONT. NO.
MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

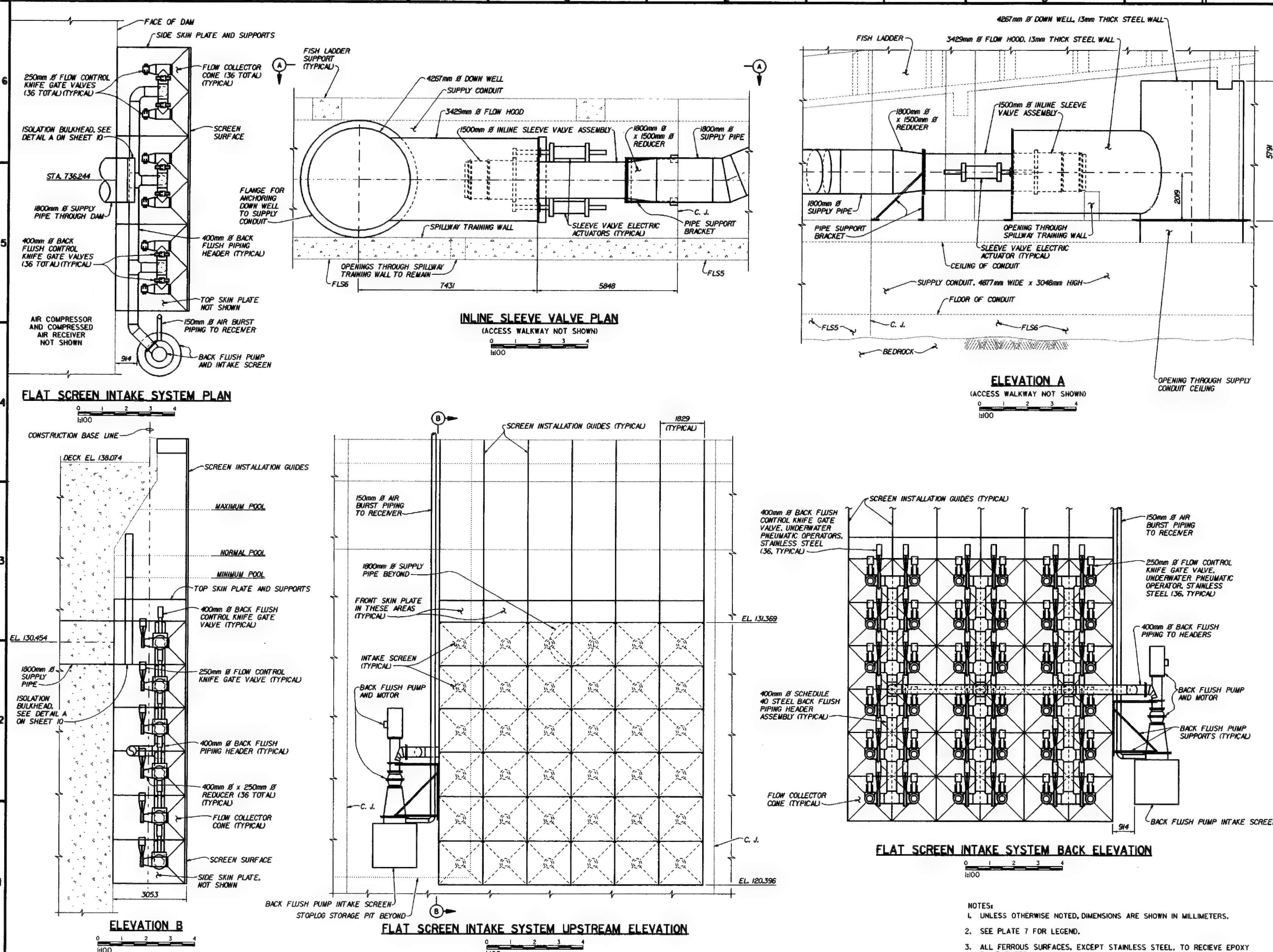
Designed by: K. RENSHAW: PE	Date: XXX
Drawn by: K. RENSHAW: PE	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, MECH. SEC.	

CADD FILENAME: L:\usr7\cad\eaw\iceawm15.dgn PLOT TIME: 20-SEP-1999 09:05

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
FLAT SCREEN INTAKE SYSTEM AND INLINE
SLEEVE VALVE DISCHARGE SUB-ALTERNATIVES
PLAN AND ELEVATION

Plate number: 14

PEN TABLE ATTACHED: ICEAWM15.HAF
SHEET MAIN SCALE: 1:340
REFERENCE FILES: EAW.BLK



NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. SEE PLATE 7 FOR LEGEND.
3. ALL FERROUS SURFACES, EXCEPT STAINLESS STEEL, TO RECIEVE EPOXY PAINT SYSTEM.

US Army Corps of Engineers
Walla Walla District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
FLAT SCREEN INTAKE SYSTEM AND INLINE
SLEEVE VALVE DISCHARGE SUB-ALTERNATIVES
PLANS AND ELEVATIONS

Designed by: K. RENSHAW; PE	Date: XXX
Drawn by: K. RENSHAW; PE	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, MECH. SEC.	

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
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Symbol	Description	Date	Appr.

MICROSTATION SE

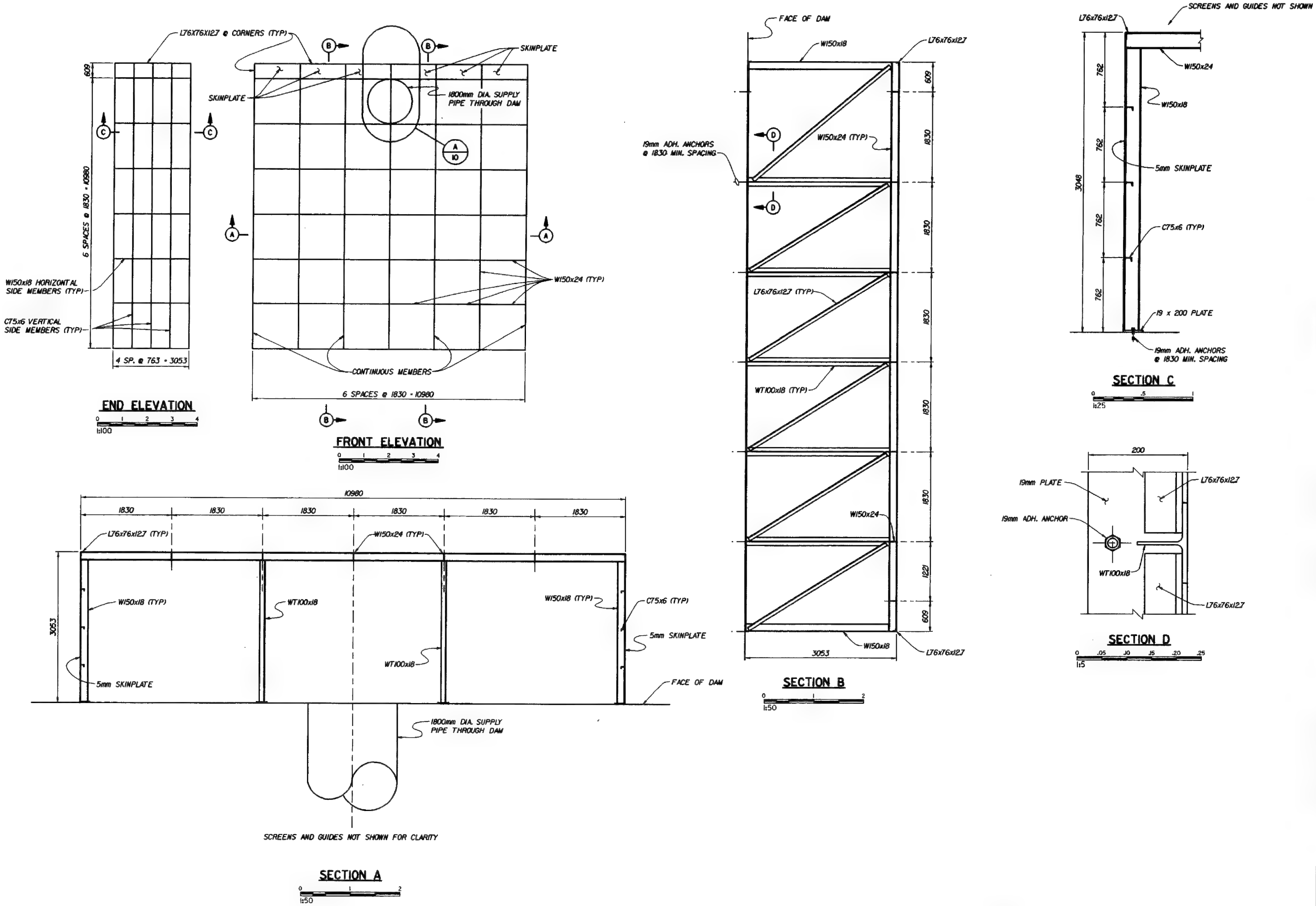
CADD FILENAME: L:\usr7\cad\eaw\iceawm16.dgn PLOT TIME: 20-SEP-1999 09:04

Plate number: 15

PEN TABLE ATTACHED: ICEAWM16.HAF

REFERENCE FILES: EAW.BLK

SHEET MAIN SCALE: X



US Army Corps of Engineers
Walla Walla District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: LOWELAND | Date: XXX
Drawn by: SHENEFIELD | Scale: AS SHOWN
Checked by: | Inv. No.: XX-B-XX
Supervised by: | File No.: XXX
Chief,Struct. Section

Submitted by:
Chief, Design Branch
Recommended by:
Chief, Engineering Division
CONT. NO.

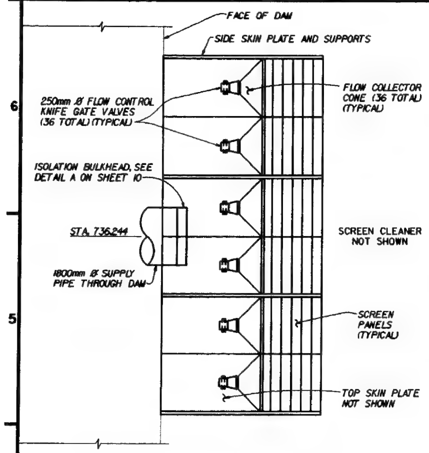
LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
FLAT SCREEN INTAKE STRUCTURE
PLAN AND DETAILS

Plate number: 16

CADD FILENAME:L:\usr7\cad\eaw\iceaws9.dgn PLOT TIME:20-SEP-1999 09:03 MICROSTATION SE

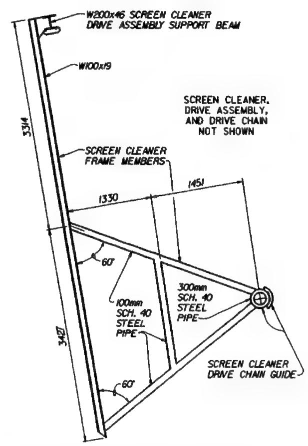
NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.

PEN TABLE ATTACHED: Iceaws9.haf
SHEET MAIN SCALE: 1:100
REFERENCE FILES: eaw.blk.tb



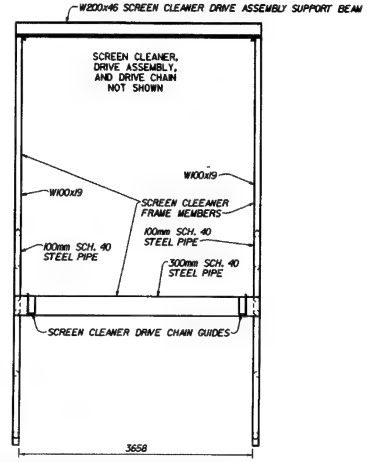
FLAT SCREEN INTAKE SYSTEM PLAN

1:100



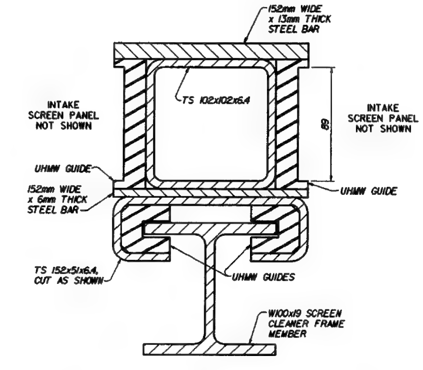
SCREEN CLEANER FRAME SIDE VIEW

1:50



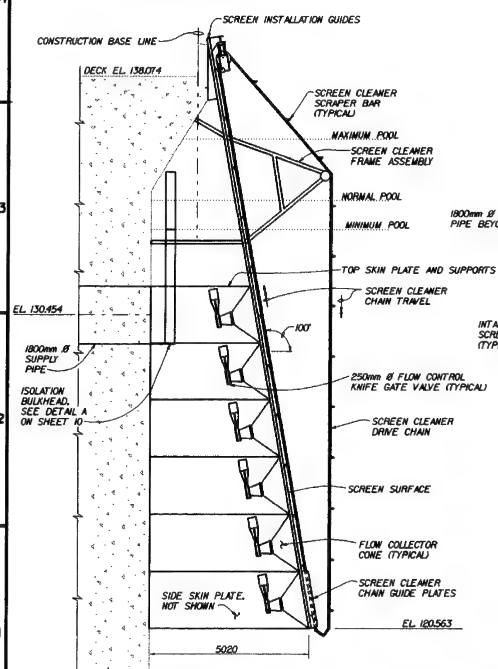
SCREEN CLEANER FRAME UPSTREAM VIEW

1:50



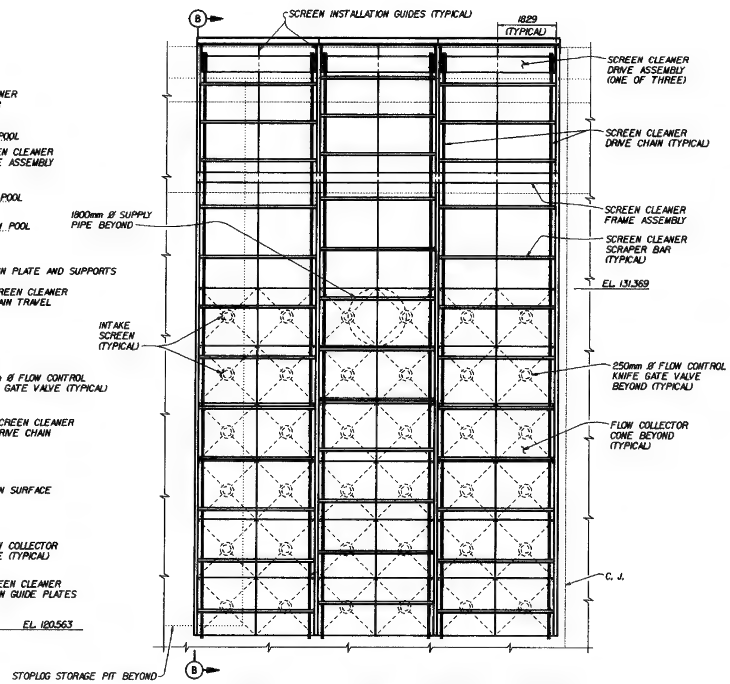
TYPICAL SCREEN INSTALLATION GUIDE

1:2.5



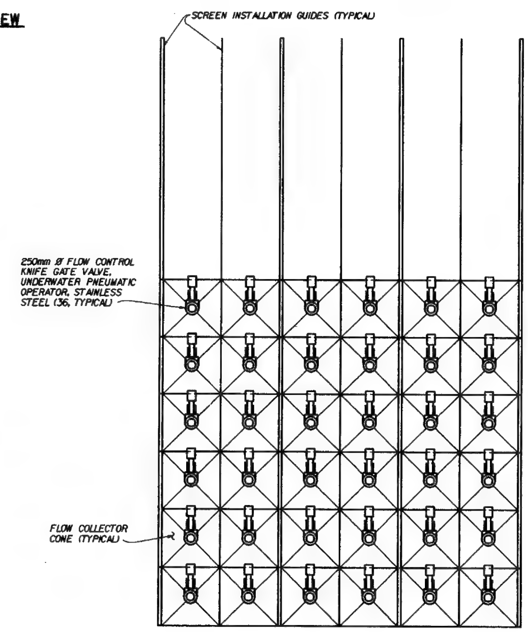
ELEVATION B

1:100



FLAT SCREEN INTAKE SYSTEM UPSTREAM ELEVATION

1:100



FLAT SCREEN INTAKE SYSTEM BACK ELEVATION

1:100

NOTES:

1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. SEE PLATE 7 FOR LEGEND.
3. ALL FERROUS SURFACES, EXCEPT STAINLESS STEEL, TO RECIEVE EPOXY PAINT SYSTEM.
4. THREE SCREEN CLEANER FRAME ASSEMBLIES ARE REQUIRED.

US Army Corps of Engineers
Walla Walla District

Submitted by:	
Chief, Design Branch	Date
Recommended by:	
Chief, Engineering Division	Date
CONT. NO.	

Designed by: K. RENSHAW; PE	Date: XXX
Drawn by: K. RENSHAW; PE	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, MECH. SEC.	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
FLAT SCREEN INTAKE SYSTEM WITH
TRAVELING SCREEN CLEANER SUB-ALTERNATIVE
PLAN AND ELEVATIONS

Plate number: 17

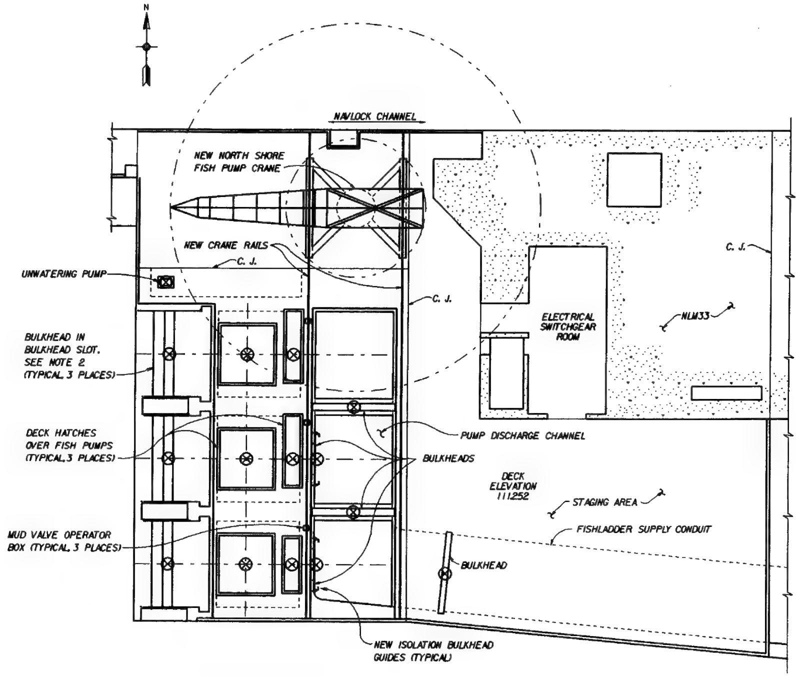
MICROSTATION SE

CADD FILENAME: L:\usr7\cad\eaw\iceawml7.dgn PLOT TIME: 20-SEP-1999 09:03

PEN TABLE ATTACHED: ICEAWMI7.HAF

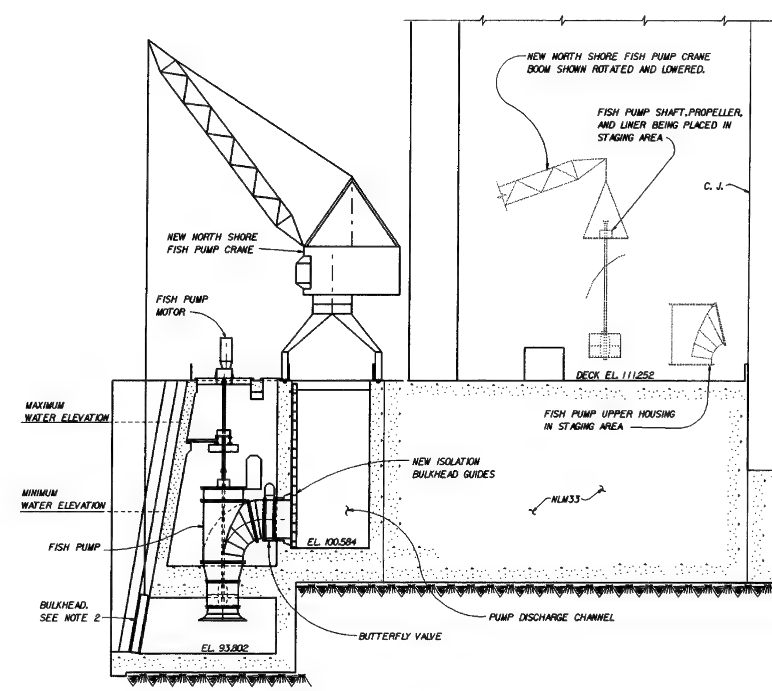
SHEET MAIN SCALE: X

REFERENCE FILES: EAW.BLK



NORTH SHORE FISH PUMP CRANE PLAN

0 5 10
1:200



NORTH SHORE FISH PUMP CRANE ELEVATION

0 5 10
1:200

LEGEND:

C.J. = CONTRACTION JOINT
NLMXX = NAVLOCK MONOLITH NUMBER

CRANE SPECIFICATIONS:

TYPE = WHIRLY, STIFF LEG DERRICK
CAPACITY = 28,000 Kg AT 12.2 METERS
CAPACITY = 11,000 Kg AT 18 METERS
MAXIMUM RADIUS = 18 METERS
MINIMUM RADIUS = 6 METERS
RAIL SPACING = 5.9 METERS
CRANE TRAVEL = 24 METERS
MAXIMUM BOOM HEIGHT = 24.2 METERS
BOOM ROTATION = 360 DEGREES

NOTES:

1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN METERS.
2. BULKHEADS WOULD BE PLACED WHERE SHOWN FOR FISH PUMP MAINTENANCE. BULKHEADS WOULD BE REPLACED WITH TRASH RACKS FOR FISH PUMP OPERATION.
3. ⊗ - TYPICAL PICK POINT
4. MUD VALVE OPERATORS WILL REQUIRE RELOCATION TO INSTALL WEST CRANE RAIL.

US Army Corps of Engineers
Walla Walla District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: K. RENSHAW PE | Date: XXX
Drawn by: K. RENSHAW PE | Scale: AS SHOWN
Checked by: | Inv. No.: XX-B-XX
Supervised by: | File No.: XXX
Chief, MECH. SEC.

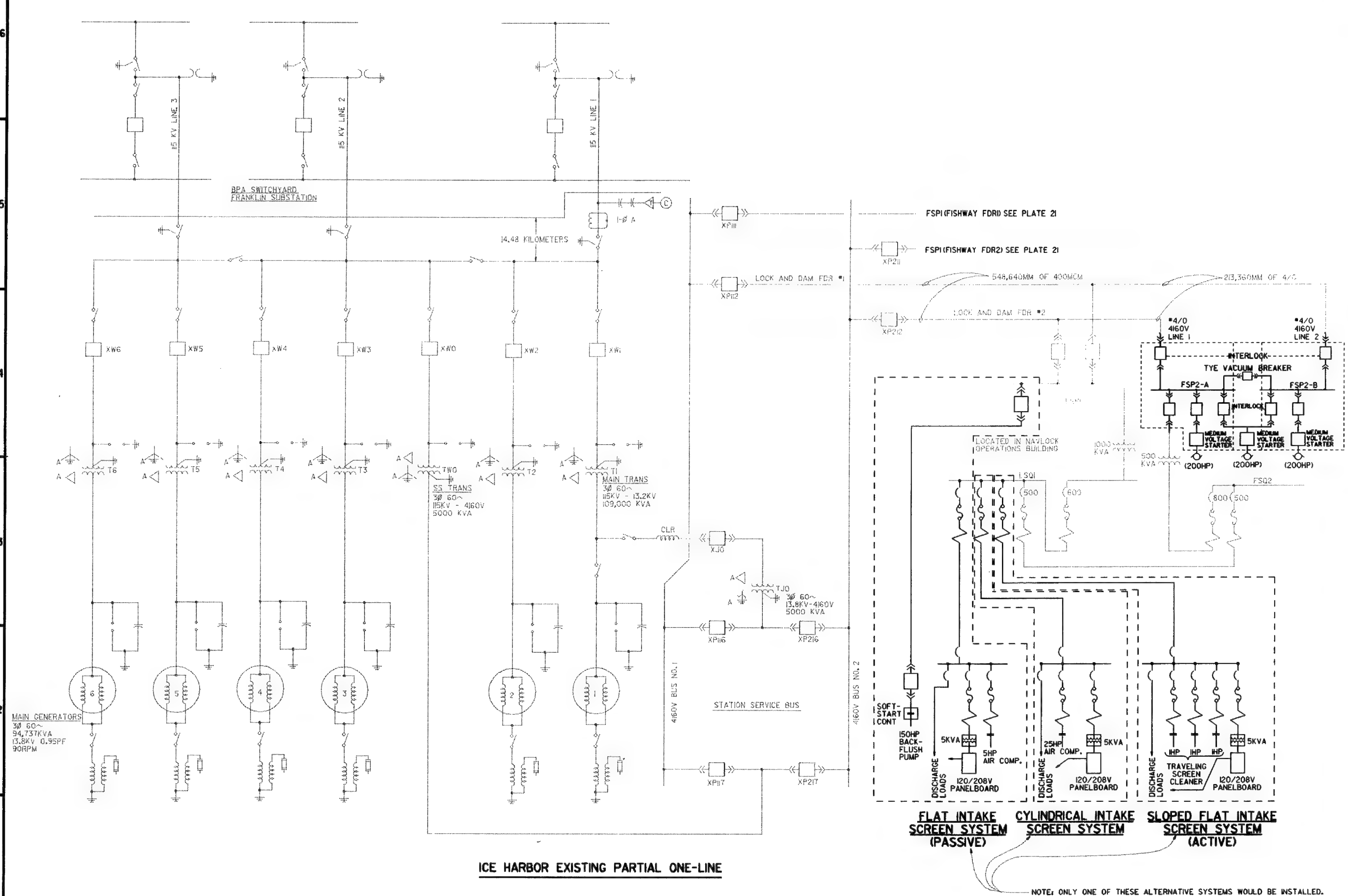
Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
ALL ALTERNATIVES
NORTH SHORE FISH PUMP CRANE

Plate number: 18

CADD FILENAME: L:\usr7\cad\eaw\iceawm18.dgn PLOT TIME: 20-SEP-1999 09:01
MICROSTATION SE

PEN TABLE ATTACHED: ICEAWM18.HAF
SHEET MAIN SCALE: 1:200
REFERENCE FILES: EAW.BLK



ICE HARBOR EXISTING PARTIAL ONE-LINE

US Army Corps of Engineers
Walla Walla District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: DEWITT
Drawn by: RUZICKA
Checked by:
Supervised by:
Chief, ELECT DES SEC
Date: XXX
Scale: AS SHOWN
Dwg. No.: XX-B-XX
File No.: XXX

Submitted by:
Chief, Design Branch
Recommended by:
Chief, Engineering Division
CONT. NO.

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
NORTH SHORE ALTERNATIVE NUMBER 3
POWER ONE-LINE DIAGRAM

Plate number: 19

CADD FILENAME: L:\usr7\cad\eaw\iceaw18.dgn PLOT TIME: 20-SEP-1999 08:46
MICROSTATION SE
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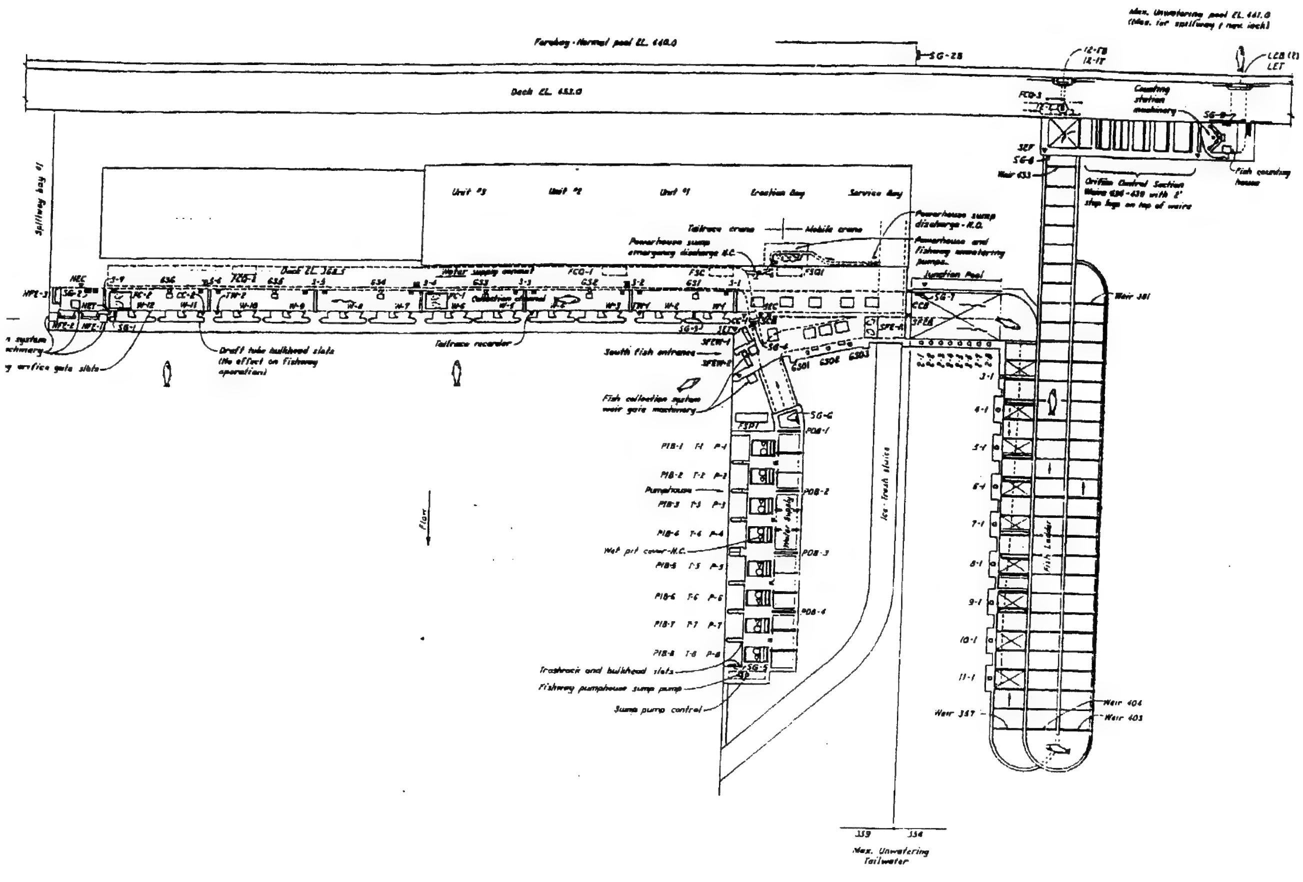
REFERENCE FILES: eaw.blk
SHEET MAIN SCALE: 1:1



LEGEND

N.O.	Normally open
N.C.	Normally closed
▽	Wet pit cover (8)
▼	Gage well locations
■	Mud valve operator locations on deck (18)
○	Sluice gate operator locations (26)
▣	Mud valve operator in gallery (3)
12-1 Ⓢ	Sluice gate operator in gallery (1)
◯	Mud valve operator locations in pumphouse (8)
——	Gravity flow
~~	Gravity flow plus pumped flow
——	Pumped flow
	Upstream migrating fish
NFE1-3	North fish entrance weir gates
NEC	North fish entrance channel float well
NET	North fish entrance tailrace float well
FC-1, 2	Fish collection channel wing gates
CC-1, 2	Collection channel float wells
TW-1, 2	Tailrace float wells
SEC	South fish entrance channel float well
SET	South fish entrance tailrace float well
SCB	Supply conduit bulkhead slot
CCB	Collection channel bulkhead slot
SFEB	South fish entrance bulkhead slot
S1-7	Collection channel transverse bulkhead slots
W1-12	Floating orifice gates
GS1-6	Collection channel sluice gates
GS01-03	South fish entrance sluice gates
P1-8	Fishway pumps - 300 C.F.S. at 4.5 ft. head
POB-1-4	Pumphouse bulkhead slots
SEF	South exit float well
2-1, 12-1	Fish ladder diffusers (11) and sluice gates (27)
SFEW-1, 2	South fish entrance weir gates
SFE-1	South fish entrance wing gate (1)
FSC	Fishway main control switchboard
FSQ1	Fishway load center
FCQ1-3	Fishway motor control centers
FSP1	4160 V. Fishway switchgear
LCB	Ladder exit bulkhead
LET	Ladder exit trash rack
T-1-8	Pumphouse trash racks
PIB-1-8	Pumphouse bulkhead slots
12-1T	Gravity flow trash rack
12-1B	Gravity flow bulkhead
■ SG-1-9, 28	Staff gages

SOUTH SHORE FISHWAY SYSTEM

NOT TO SCALE

US Army Corps of Engineers
Walla Walla District

Submitted by:		
Chief, Design Branch	Date	
Recommended by:		
Chief, Engineering Division	Date	
CONT. NO.		

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS WALLA WALLA, WASHINGTON	Designed by: K. RENSHAW; PE	Date: XXX
	Drawn by: K. RENSHAW; PE	Scale: AS SHOWN
	Checked by:	Inv. No.: XX-B-XX
	Supervised by: Chief, MECH SEC.	File No.: XXX

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
EXISTING
SOUTH SHORE ADULT FISHWAY SYSTEM

Plate number: 20

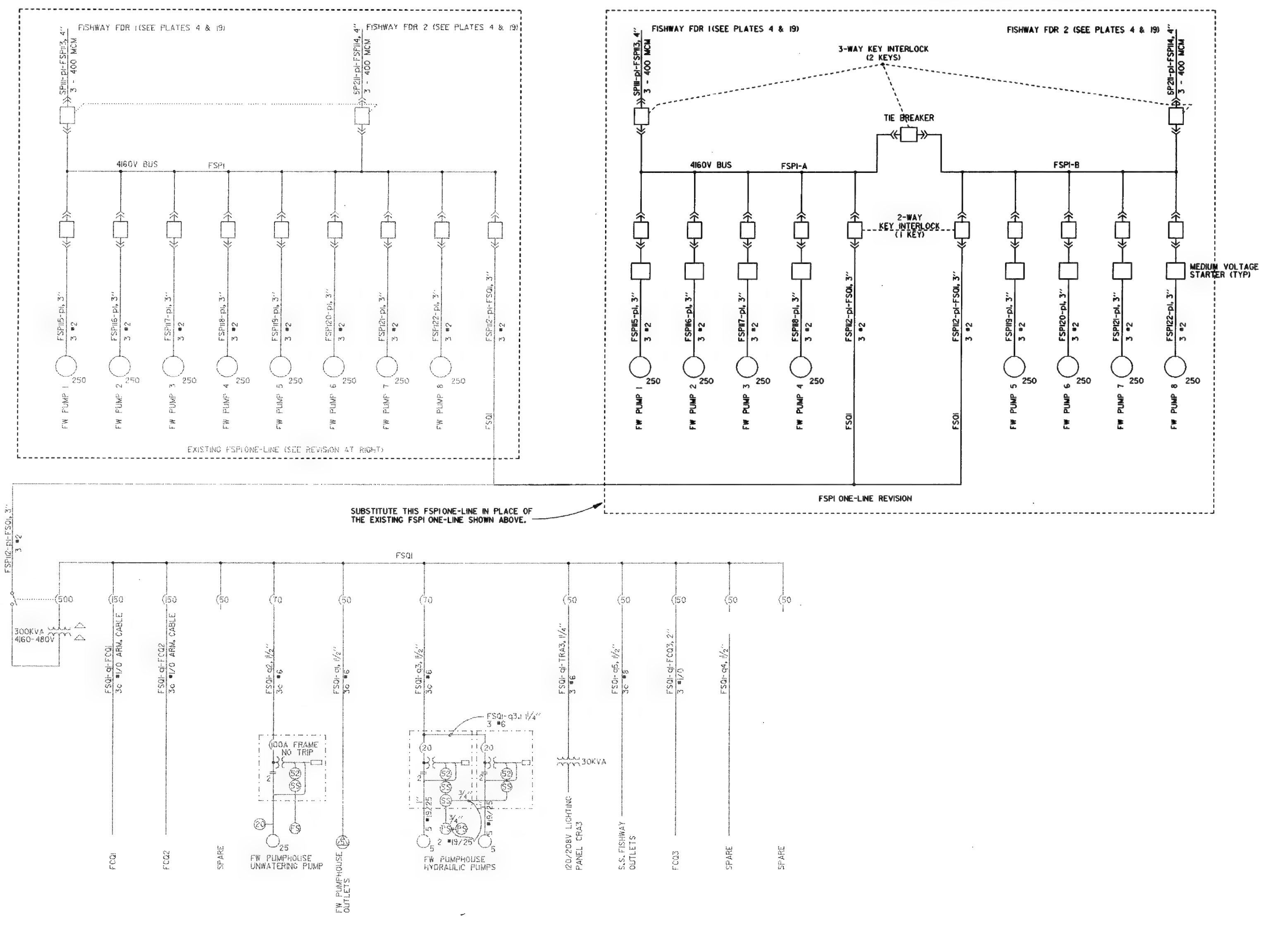
CADD FILENAME:L:\usr7\cad\eaw\eawscn19.dgn PLOT TIME:20-SEP-1999 08:46

MICROSTATION SE

PEN TABLE ATTACHED: NO

SHEET MAIN SCALE: 50

REFERENCE FILES: EAW.BLK; EAWSCN19.TIF



EXISTING ICE HARBOR SOUTH FISHWAY PARTIAL ONE-LINE

US Army Corps of Engineers
Walla Walla District

Submitted by:	
Chief, Design Branch	Date
Recommended by:	
Chief, Engineering Division	Date
CONT. NO.	
MICROSTATION SE	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: DEWITT	Date: XXX
Drawn by: RUZICKA	Scale: AS SHOWN
Checked by:	Rev. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, ELEC DES SEC	

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
ICE HARBOR LOCK AND DAM
SOUTH SHORE ALTERNATIVE NUMBER 2
POWER ONE-LINE
DIAGRAM

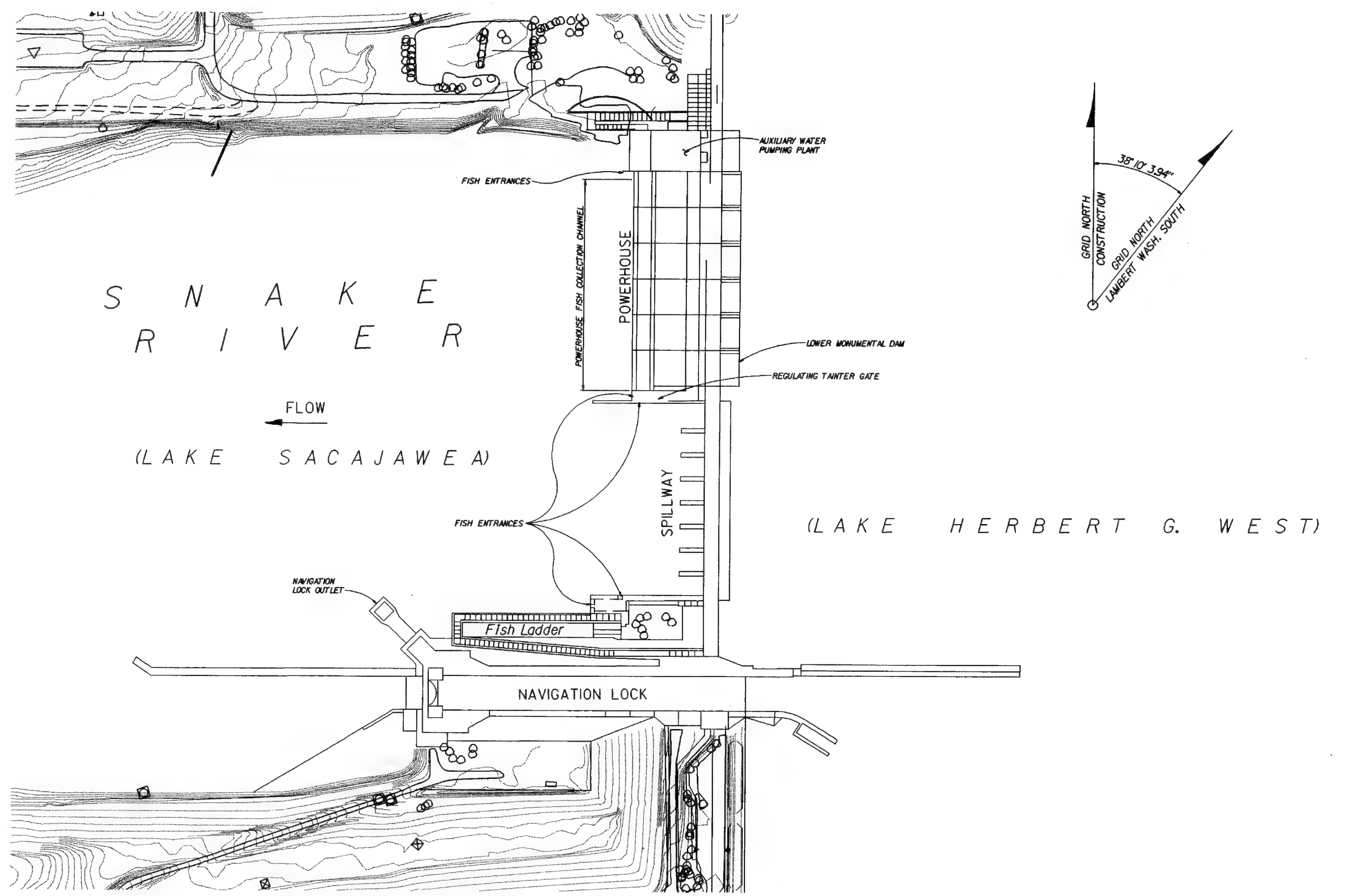
Plate number: 21

CADD FILENAME: L:\usr7\cad\eax\iceawe20.dgn PLOT TIME: 20-SEP-1999 08:46

PEN TABLE ATTACHED: Iceawe20.hpf

REFERENCE FILES:

SHEET MAIN SCALE:



LOWER MONUMENTAL DAM SITE PLAN

0 50 100
1:2000

NOTE:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN METERS.

US Army Corps of Engineers
Walla Walla District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: K.RENSHAW;P.E. Date: XXX
Drawn by: K.RENSHAW;P.E. Scale: AS SHOWN
Checked by: Inv. No.: XX-B-XX
Supervised by: File No.: XXX
Chief, MECH. DES. SEC.

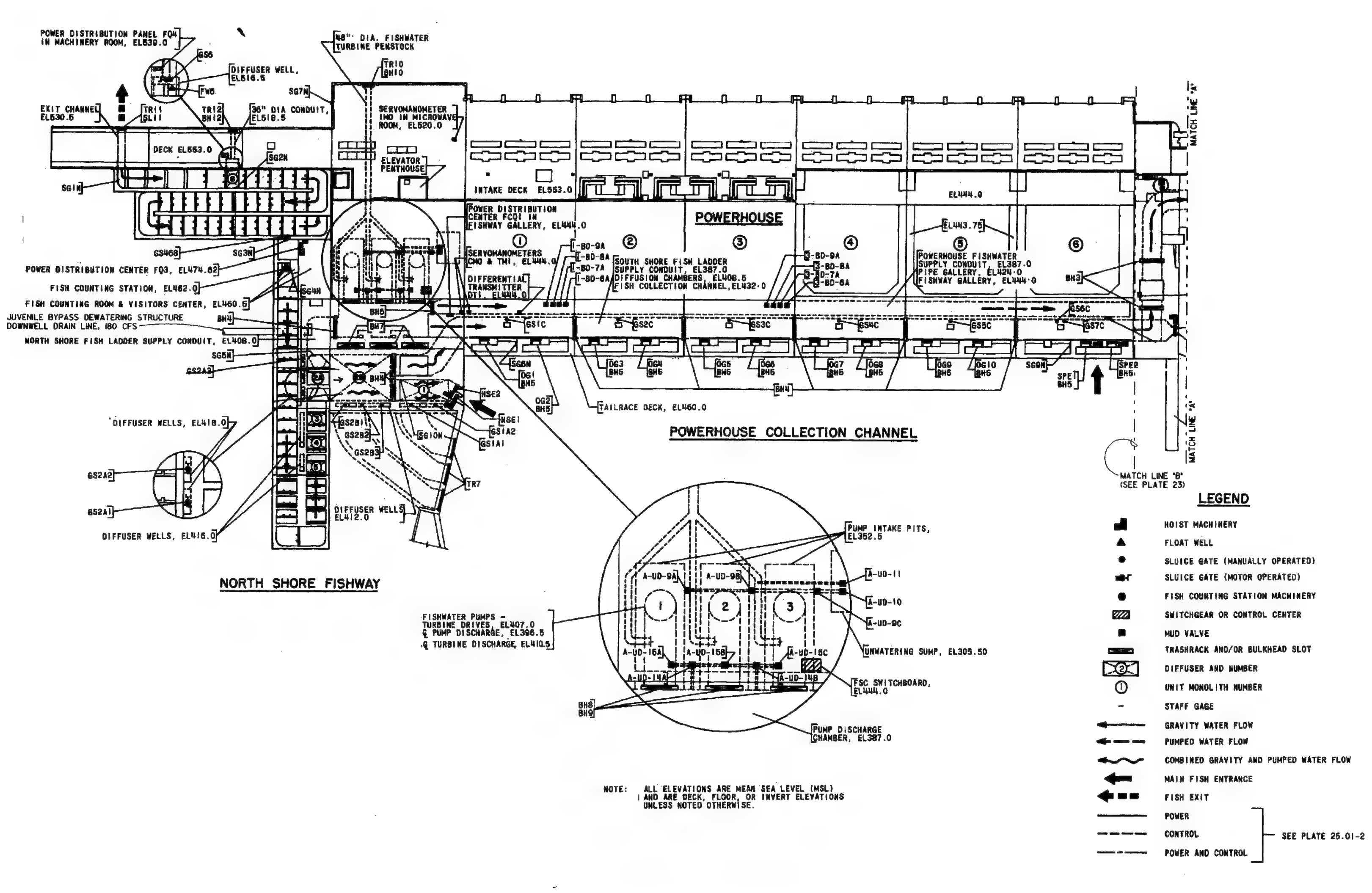
Submitted by:
Chief, Design Branch
Recommended by:
Chief, Engineering Division
CONT. NO.
MICROSTATION SE

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
SITE PLAN

Plate number: 22

CADD FILENAME:L:\usr7\cad\ea\lmeawgl.dgn PLOT TIME:20-SEP-1999 08:40

PEN TABLE ATTACHED: LMEAWGI.HAF
SHEET MAIN SCALE: 2000:1
REFERENCE FILES: EAW.BLK; VICINMET.DGN; LMTOPOM.DGN; LMGRIDM.2D



NORTH SHORE FISHWAY ARRANGEMENT

NOT TO SCALE

US Army Corps of Engineers
Walla Walla District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: V. DeWITT | Date: XXX
Drawn by: A/C | Scale: AS SHOWN
Checked by: | Inv. No.: XX-B-XX
Supervised by: | File No.:
Chief, ELEC. SEC.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
EXISTING
NORTH SHORE ADULT FISHWAY ARRANGEMENT

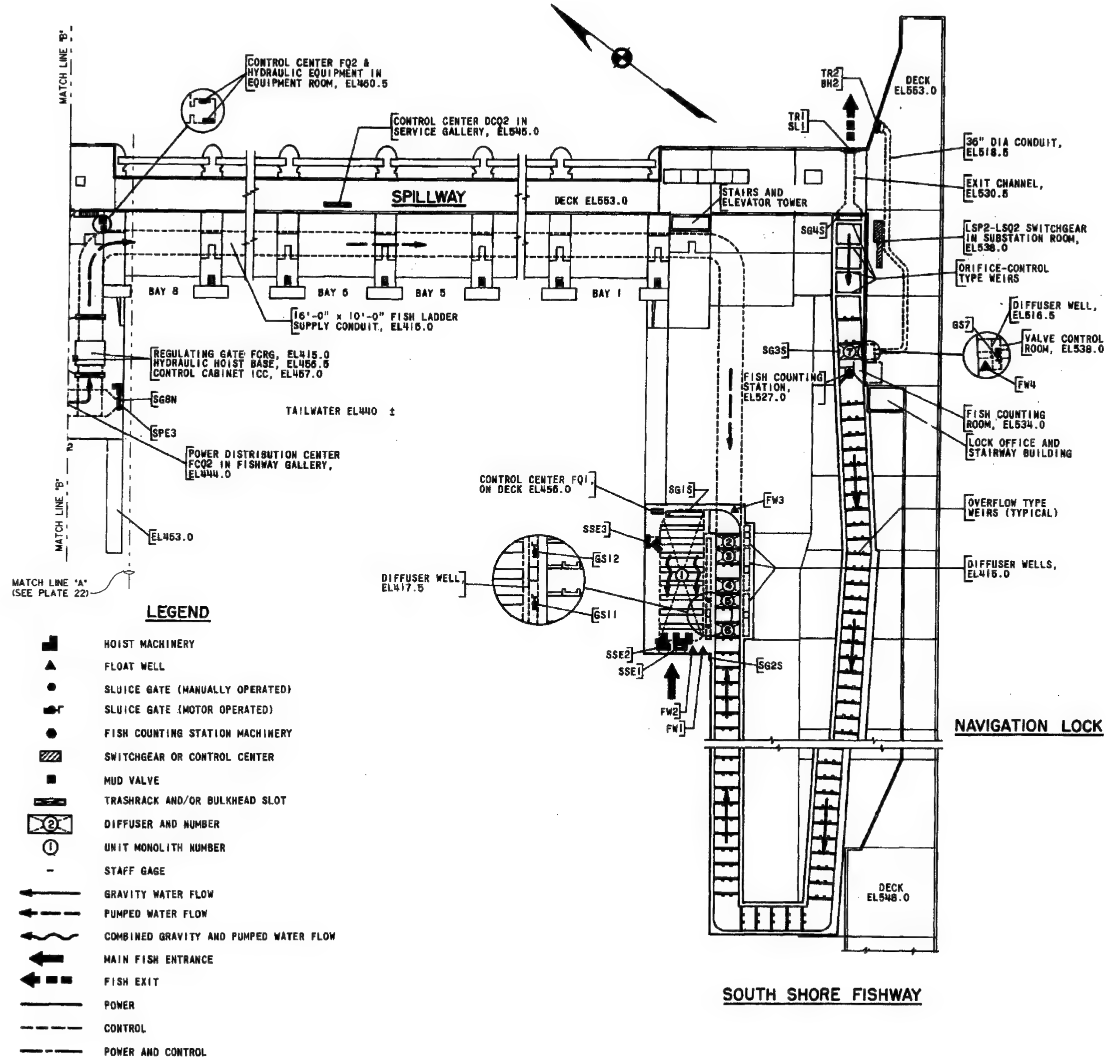
Plate number: 23

CADD FILENAME:L:\usr7\cad\eaw\lmeawe22.dgn PLOT TIME:20-SEP-1999 08:40 MICROSTATION SE

PEN TABLE ATTACHED: NO

SHEET MAIN SCALE: 1:100

REFERENCE FILES: EAW.BLK, LMEAWE22.CIT



SOUTH SHORE FISHWAY ARRANGEMENT

NOT TO SCALE

US Army Corps of Engineers
Walla Walla District

Submitted by:	Date
Chief, Design Branch	
Recommended by:	Date
Chief, Engineering Division	
CONT. NO.	

MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: V. DeWITT	Date: XXX
Drawn by: A/C	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, ELEC. SEC.	

CADD FILENAME:L:\usr7\cad\eaw\lmeawe23.dgn PLOT TIME:20-SEP-1999 08:40

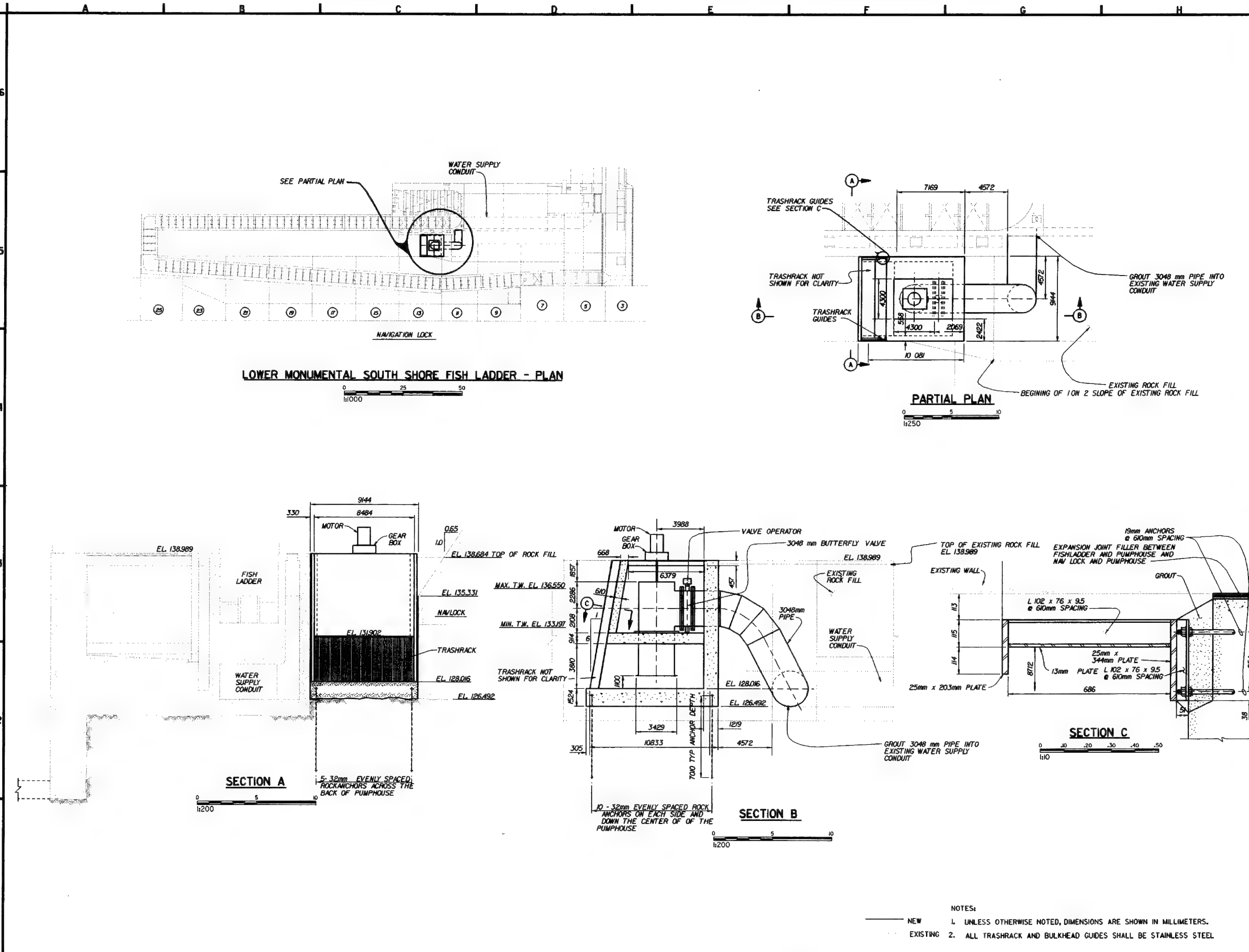
LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
EXISTING
SOUTH SHORE ADULT FISHWAY ARRANGEMENT

Plate number: 24

PEN TABLE ATTACHED: NO

SHEET MAIN SCALE: 1:100

REFERENCE FILES: EAW.BLK, LMEAWE23.CIT



NOTES:

NEW

EXISTING

1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. ALL TRASHRACK AND BULKHEAD GUIDES SHALL BE STAINLESS STEEL

US Army Corps of Engineers
Walla Walla District

Symbol	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.

Designed by: LOWELAND	Date: XXX
Drawn by:	Scale: AS SHOWN
Checked by:	Inv. No.: XX-8-XX
Supervised by:	File No.: XXX
Chief,STRUCT. DES. SEC.	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 1
PUMP PLANT SYSTEM
PUMPHOUSE
PLAN & SECTIONS

Plate number: 25

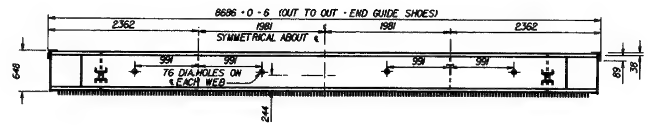
MICROSTATION SE

CADD FILENAME:L:\usr7\cad\eaw\eaws24.dgn PLOT TIME:20-SEP-1999 11:13

PEN TABLE ATTACHED: X

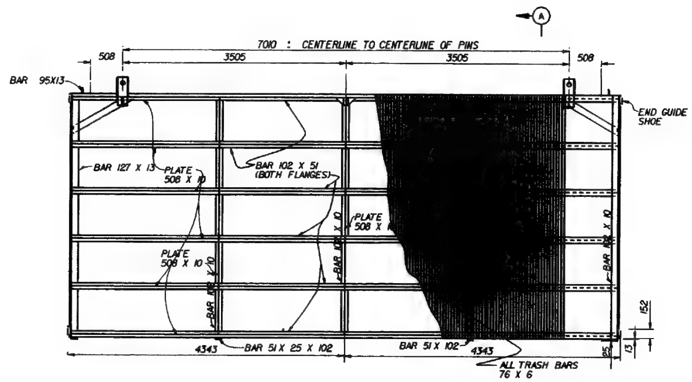
REFERENCE FILES: X

SHEET MAIN SCALE: 1:100



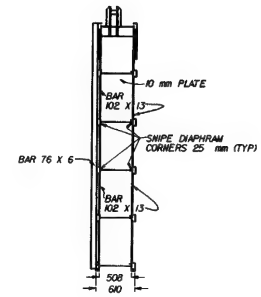
PLAN

1:50



ELEVATION

1:50



SECTION A

1:50

NOTES:
1. UNLESS OTHERWISE NOTED,DEMENSIONS ARE SHOWN IN MILLIMETERS.

US Army Corps of Engineers
Walla Walla District

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.
MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

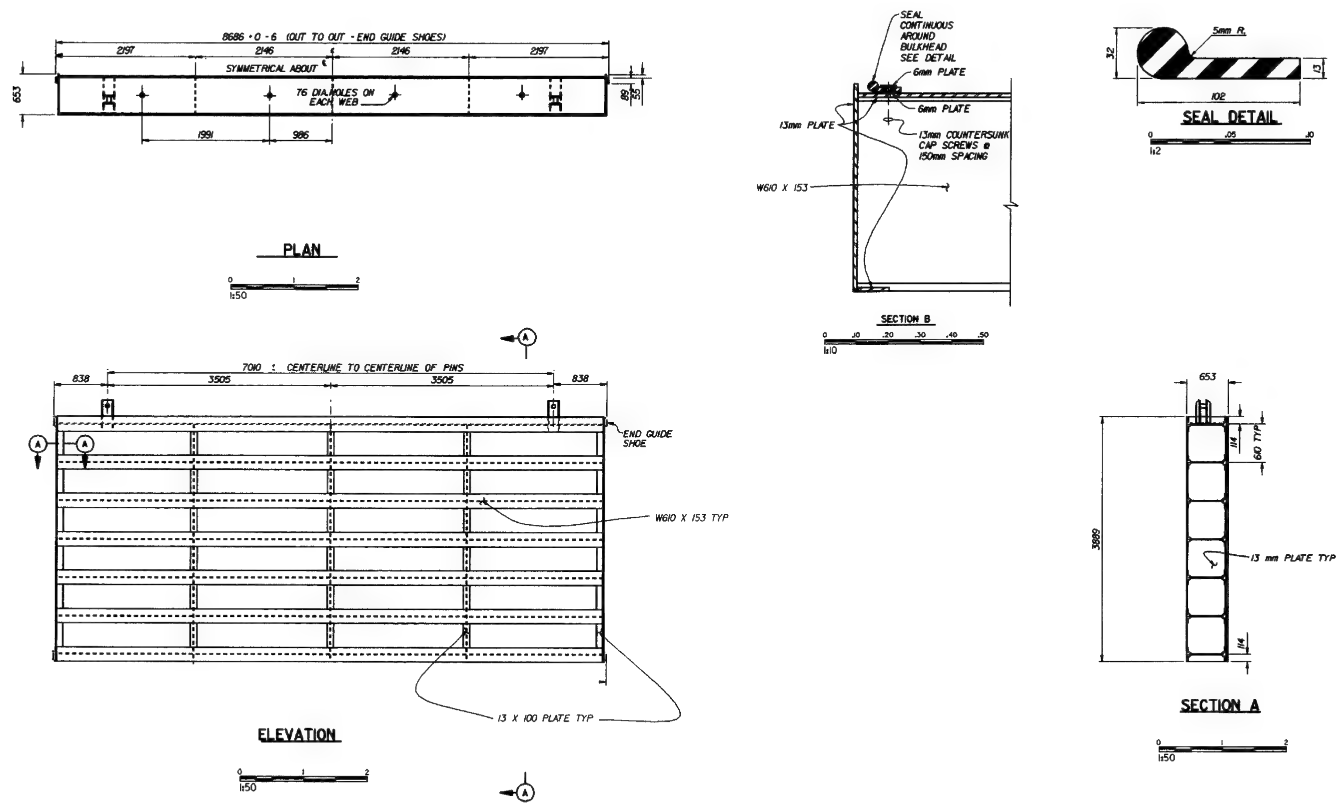
Designed by: LOWELAND	Date: XXX
Drawn by:	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, ____ SEC.	

CADD FILENAME: L:\usr7\cad\eaw\lm28.dgn PLOT TIME: 20-SEP-1999 08:39

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 1
PUMP PLANT SYSTEM
TRASH RACK
PLAN, ELEVATION, AND SECTION

Plate number: 26

PEN TABLE ATTACHED: X
REFERENCE FILES: EAW.BLK
SHEET MAIN SCALE: 1:100



NOTES:
1. UNLESS OTHERWISE NOTED, DEMENSIONS ARE SHOWN IN MILLIMETERS.

US Army Corps of Engineers
Walla Walla District

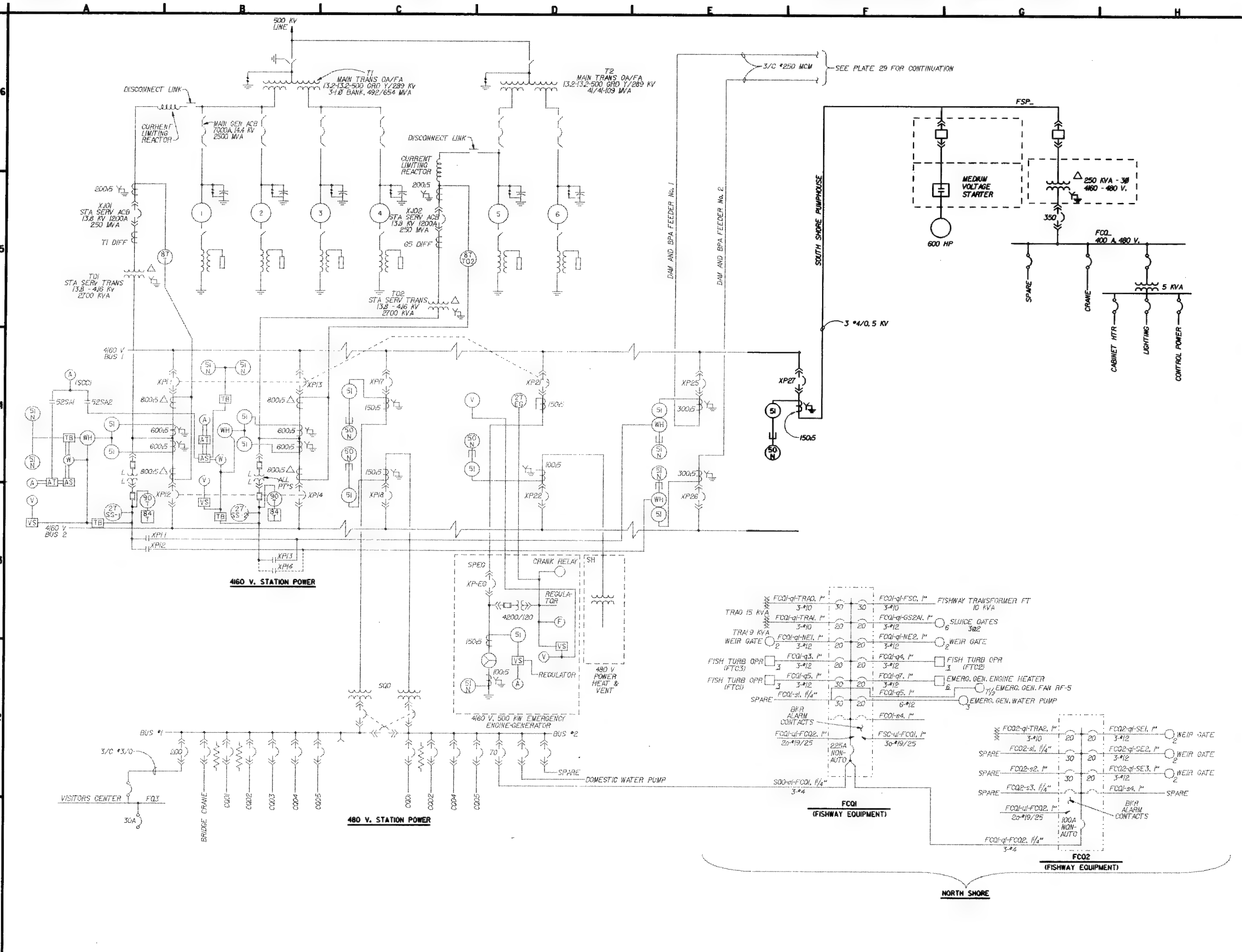
Submitted by:		
Chief, Design Branch	Date	
Recommended by:		
Chief, Engineering Division	Date	
CONT. NO.		

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS WALLA WALLA, WASHINGTON	Designed by: LOMELAND	Date: XXX
	Drawn by:	Scale: AS SHOWN
	Checked by:	Inv. No.: XX-B-XX
	Supervised by:	File No.: XXX
	Chief, ---- SEC.	

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 1
PUMP PLANT SYSTEM
BULKHEAD
PLAN, ELEVATION, AND SECTION

Plate number: 27

MICROSTATION SE
PLOT TIME: 20-SEP-1999 08:39
CADD FILENAME: L:\usr7\cad\eaw\lm27.dgn
PEN TABLE ATTACHED: X
REFERENCE FILES: EAW.BLK
SHEET MAIN SCALE: 1:100



US Army Corps of Engineers
Walla Walla District

Submitted by:	Date
Chief, Design Branch	
Recommended by:	
Chief, Engineering Division	Date
CONT. NO.	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: DEWITT	Date: XXX
Drawn by: ROGERS	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, ELECT. DES. SEC.	

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 1
FISHWAY EQUIPMENT
ONE-LINE DIAGRAM

Plate number: 28

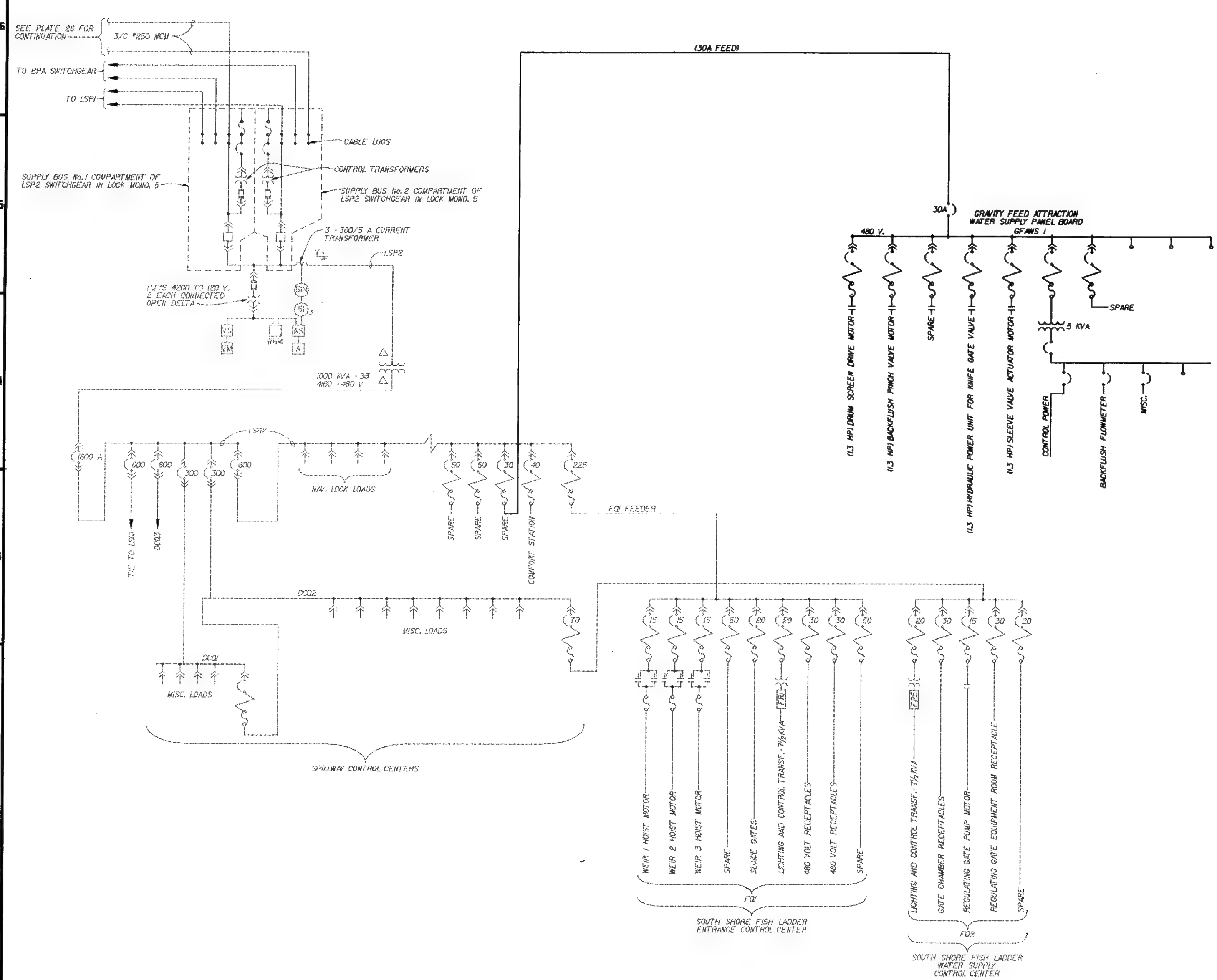
MICROSTATION SE

CADD FILENAME:L:\usr7\cad\eaw\lceawe28.dgn PLOT TIME:20-SEP-1999 08:38

PEN TABLE ATTACHED: lceawe27.haf

REFERENCE FILES: EAW.BLK

SHEET MAIN SCALE: 1:1



US Army Corps of Engineers
Walla Walla District

Revision	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date

CONT. NO.

MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

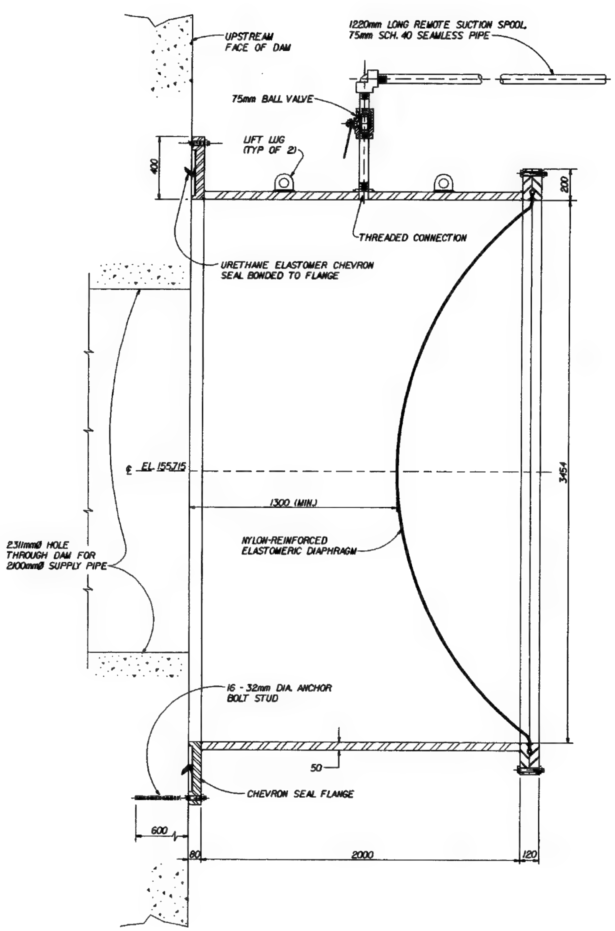
Designed by: DEWITT	Date: XXX
Drawn by: ROGERS	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, ELECT. DES. SEC.	

CADD FILENAME:L:\usr7\cad\eaw\iceawe29.dgn PLOT TIME:20-SEP-1999 08:38

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
FISHWAY EQUIPMENT
ONE-LINE DIAGRAM

Plate number: 29

PEN TABLE ATTACHED: iceawe28.hof
REFERENCE FILES: EAW.BLK
SHEET MAIN SCALE: 1:1



TEMPORARY BULKHEAD ASSEMBLY - SECTION

0 50
1:20

NOTES:
1. 16 HOLES TO BE DRILLED IN CHEVRON SEAL FLANGE.
2. CAN AND FLANGE MATERIAL ASTM A-36.
3. DIAPHRAGM TEST PRESSURE: 345 kPa.
4. CHEVRON SEAL TEST PRESSURE: 345 kPa.
5. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
6. TEMPORARY BULKHEAD WILL BE MOUNTED TO UPSTREAM FACE OF DAM WHILE WATER SUPPLY PIPE IS BEING INSTALLED. TEMPORARY BULKHEAD WILL BE REMOVED AFTER SUPPLY PIPE IS GROUTED INTO DAM.

US Army Corps of Engineers
Walla Walla District

Revision	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

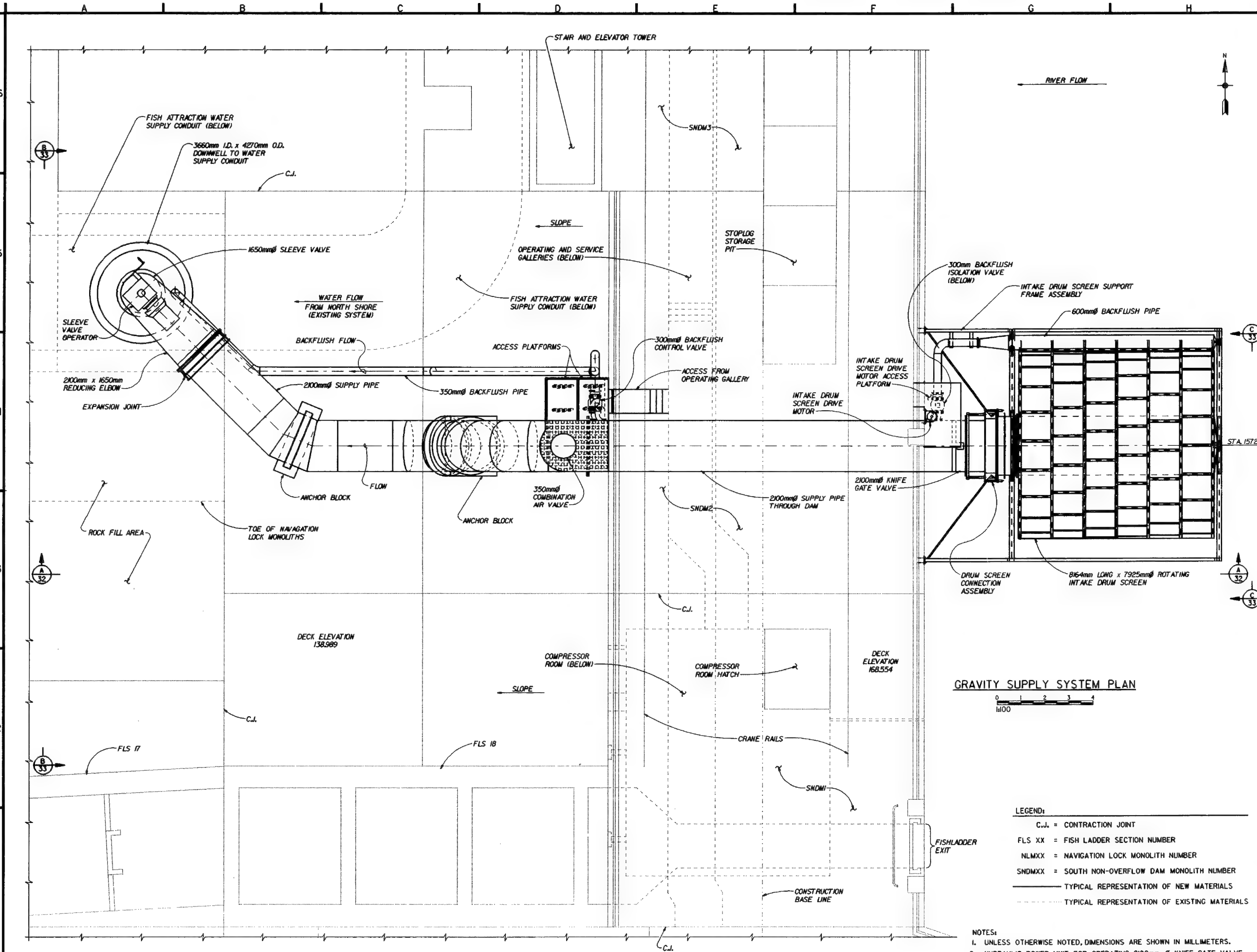
Designed by: K.RENSHAW, P.E.	Date: XXX
Drawn by: K.RENSHAW, P.E.	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, MECH. SEC.	

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
TEMPORARY BULKHEAD - SECTION

Plate number: 30

MICROSTATION SE
CADD FILENAME: L:\usr7\cad\eaw\lmcas1.dgn PLOT TIME: 20-SEP-1999 08:37

PEN TABLE ATTACHED: no
SHEET MAIN SCALE: 20:1
REFERENCE FILES: eaw.blk



GRAVITY SUPPLY SYSTEM PLAN

0 1 2 3 4
1:100

LEGEND:

C.J. = CONTRACTION JOINT
FLS XX = FISH LADDER SECTION NUMBER
NLMXX = NAVIGATION LOCK MONOLITH NUMBER
SNDMXX = SOUTH NON-OVERFLOW DAM MONOLITH NUMBER
——— TYPICAL REPRESENTATION OF NEW MATERIALS
- - - - TYPICAL REPRESENTATION OF EXISTING MATERIALS

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. HYDRAULIC POWER UNIT FOR OPERATING 2100mm Ø KNIFE GATE VALVE NOT SHOWN.

US Army Corps of Engineers
Walla Walla District

Revision	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: K. RENSHAWI PE — Date: XXX
Drawn by: K. RENSHAWI PE — Scale: AS SHOWN
Checked by: — Inv. No.: XX-B-XX
Supervised by: — File No.: XXX
Chief, MECH SEC.

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
PLAN

Plate number: 31

MICROSTATION SE
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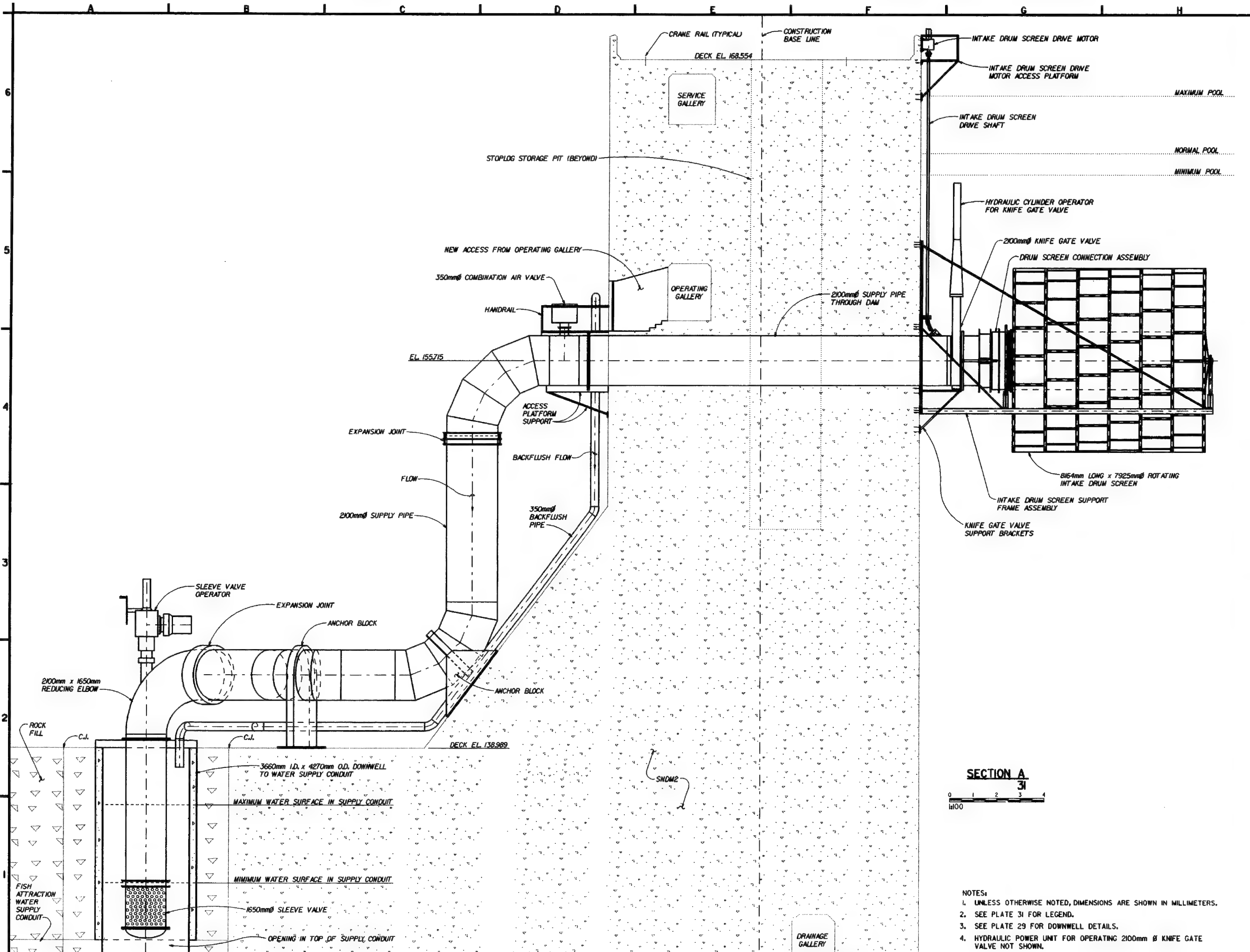
PEN TABLE ATTACHED: LMEAWM18.HAF
SHEET MAIN SCALE: 100
REFERENCE FILES: LOMOSEC3.20



US Army Corps of Engineers
Walla Walla District

Revision	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.
MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: K. RENSHAW PE	Date: XXX
Drawn by: K. RENSHAW PE	Scale: AS SHOWN
Checked by:	Inv. No.: XX-8-XX
Supervised by:	File No.: XXX
Chief, MECH SEC.	

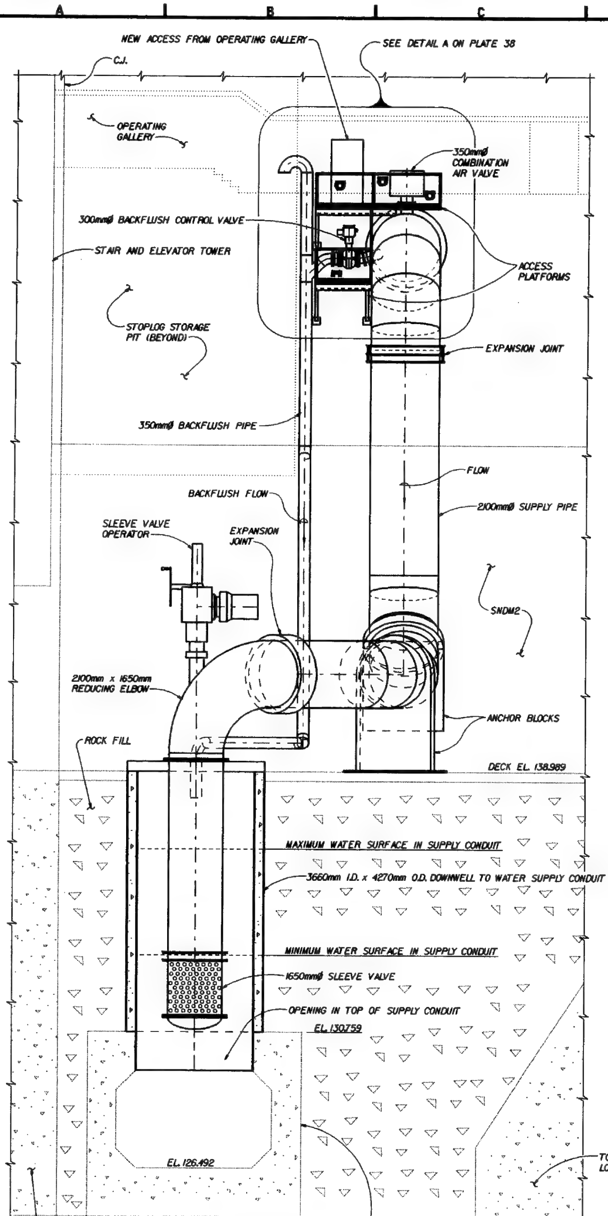
CADD FILENAME: L:\usr7\cad\eaw\lmeawml9.dgn PLOT TIME: 20-SEP-1999 08:36

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
SECTION A

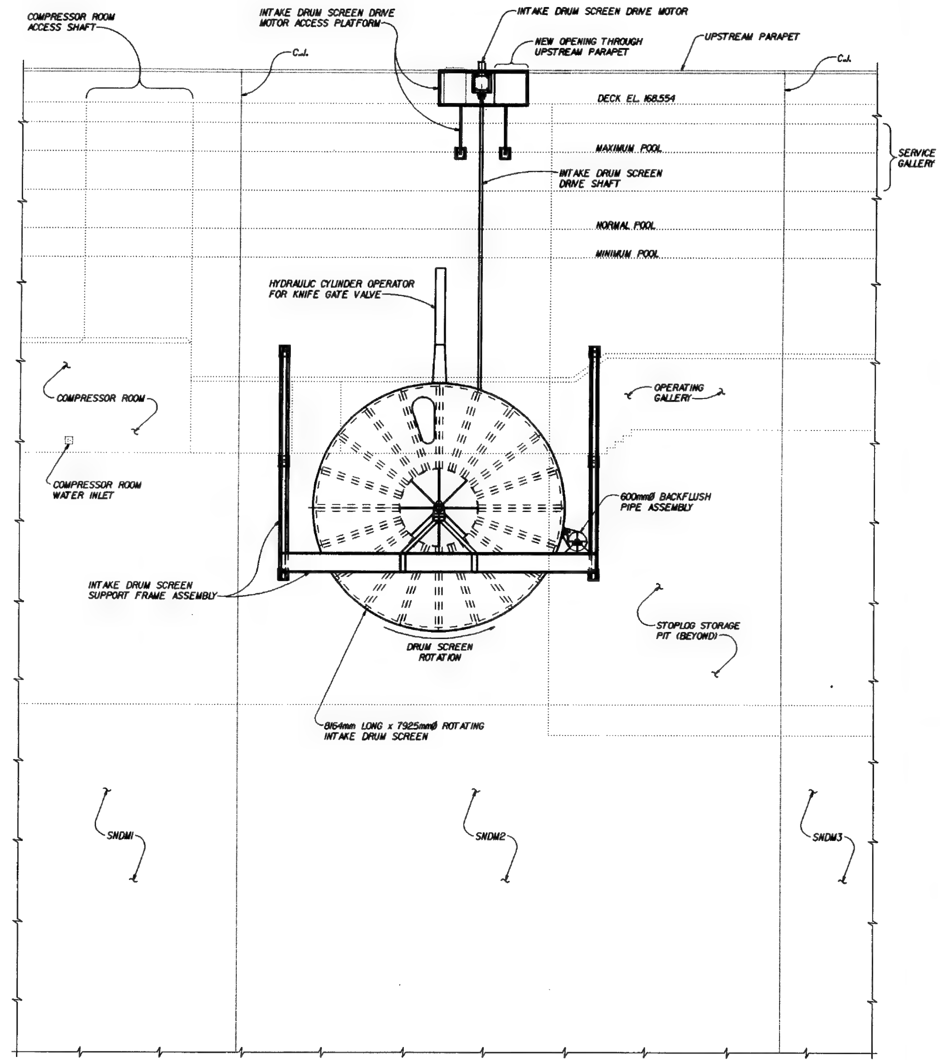
Plate number: 32

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. SEE PLATE 31 FOR LEGEND.
3. SEE PLATE 29 FOR DOWNWELL DETAILS.
4. HYDRAULIC POWER UNIT FOR OPERATING 2100mm Ø KNIFE GATE VALVE NOT SHOWN.

PEN TABLE ATTACHED: LMEAWM19.HAF
SHEET MAIN SCALE: 100
REFERENCE FILES: LOMOSEC3.20



SECTION B
31
1:100



SECTION C
31
1:100

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. SEE PLATE 31 FOR LEGEND.
3. SEE PLATE 29 FOR DOWNWELL DETAILS.

US Army Corps of Engineers
Walla Walla District

Submitted by:
Chief, Design Branch Date
Recommended by:
Chief, Engineering Division Date
CONT. NO.

Symbol	Description	Date	Appr.

MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

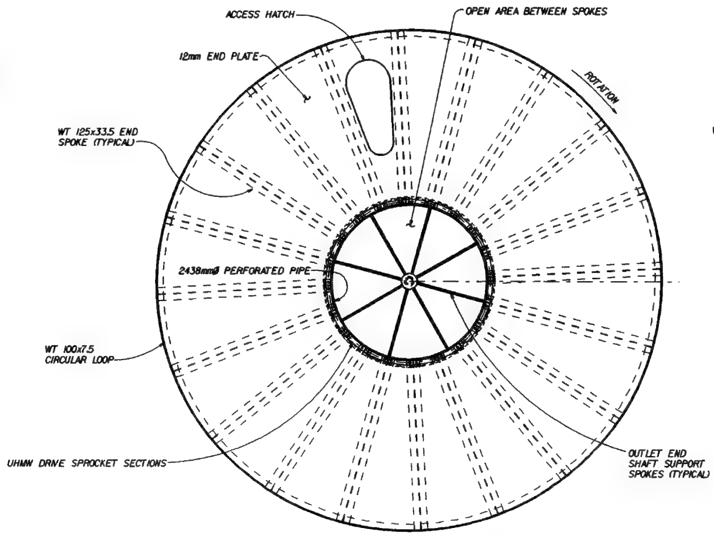
Designed by: K. RENSHAW PE Date: XXX
Drawn by: K. RENSHAW PE Scale: AS SHOWN
Checked by: Inv. No.: XX-B-XX
Supervised by: Chief, MECH SEC. File No.: XXX

CADD FILENAME:L:\usr7\cad\eaw\lmeawm20.dgn PLOT TIME:20-SEP-1999 08:36

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
SECTIONS

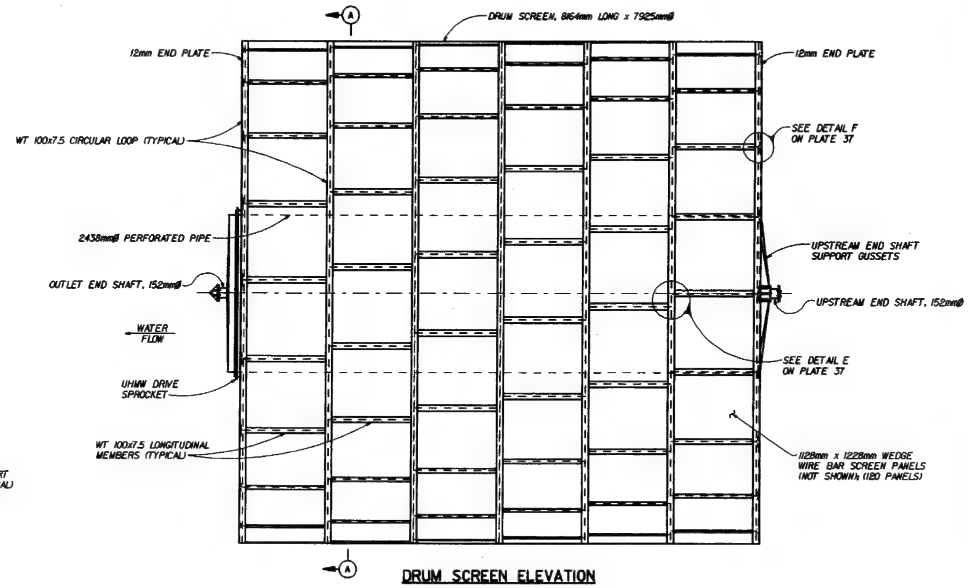
Plate number: 33

PEN TABLE ATTACHED: LMEAWM20.HAF
REFERENCE FILES: LOMOSEC3.20
SHEET MAIN SCALE: 100



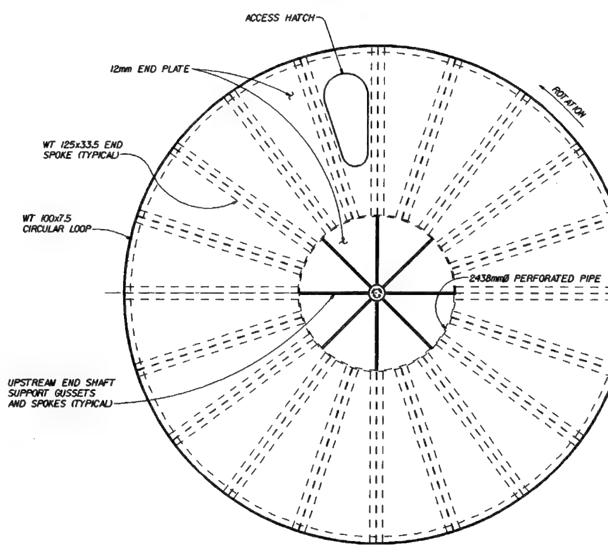
DRUM SCREEN OUTLET END ELEVATION

1:50



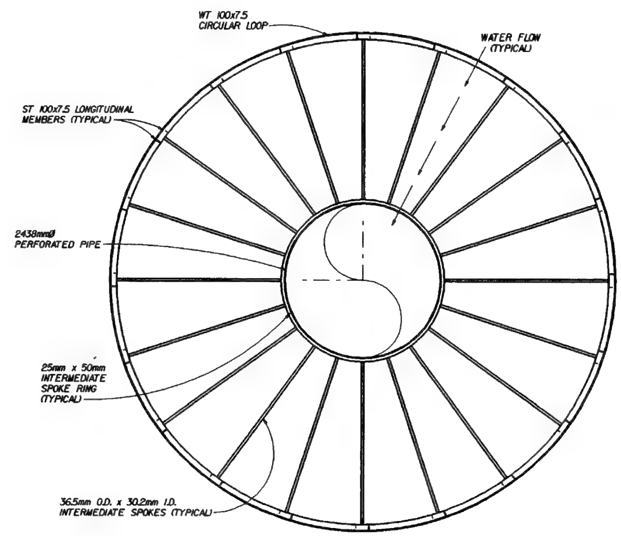
DRUM SCREEN ELEVATION

1:50



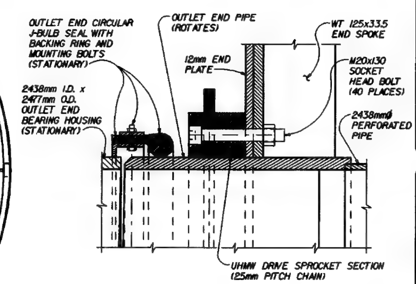
DRUM SCREEN UPSTREAM ELEVATION

1:50



SECTION A

1:50



DETAIL B
36

1:5

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. ALL FERROUS SURFACES, EXCEPT STAINLESS STEEL, TO RECEIVE EPOXY PAINT SYSTEM.

US Army Corps of Engineers
Walla Walla District

Submitted by:
Chief, Design Branch
Recommended by:
Chief, Engineering Division
CONT. NO.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

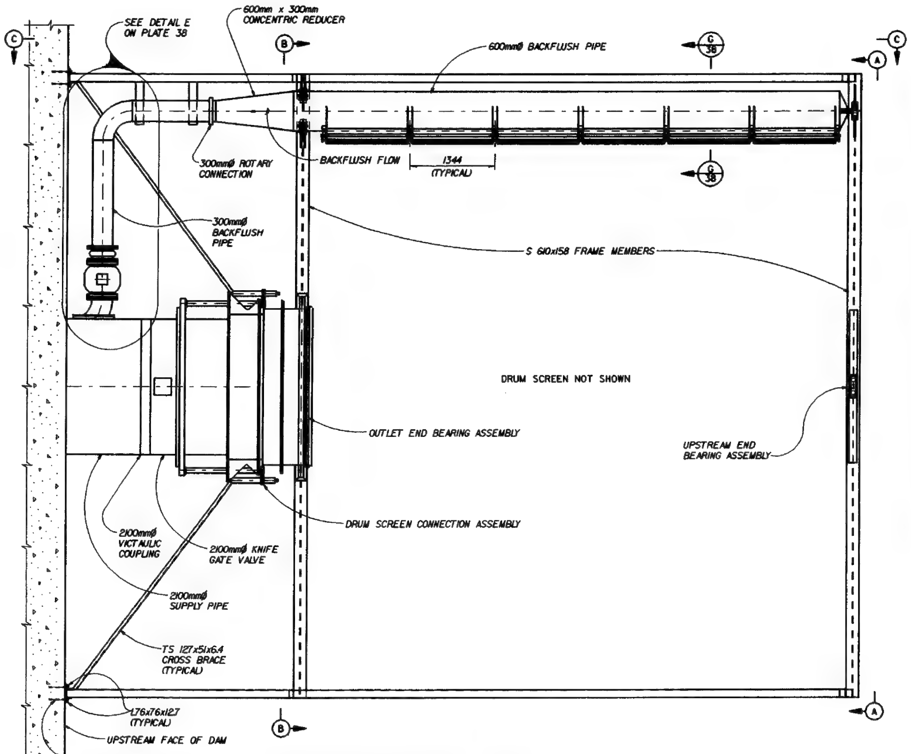
Designed by: K. RENSHAW, PE	Date: XXX
Drawn by: K. RENSHAW, PE	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, MECH SEC.	

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
ROTATING INTAKE DRUM SCREEN

Plate number: 34

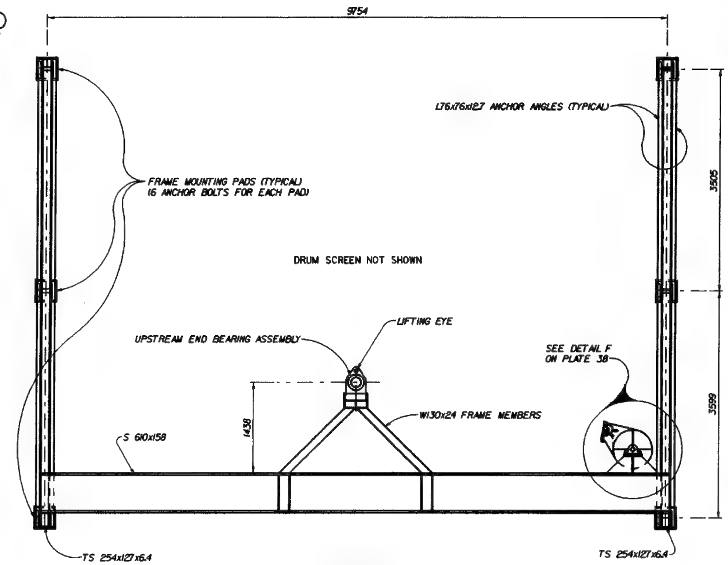
CADD FILENAME:L:\usr7\cad\eaw\1meawm21.dgn PLOT TIME:20-SEP-1999 08:35
MICROSTATION SE

PEN TABLE ATTACHED: NO
SHEET MAIN SCALE: 50
REFERENCE FILES: EAW.BLK



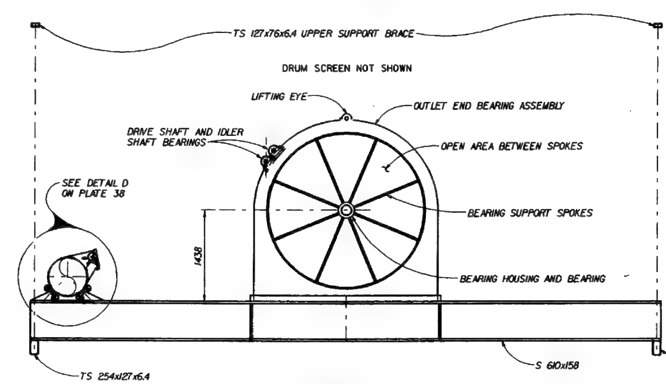
DRUM SCREEN SUPPORT FRAME PLAN

1:50



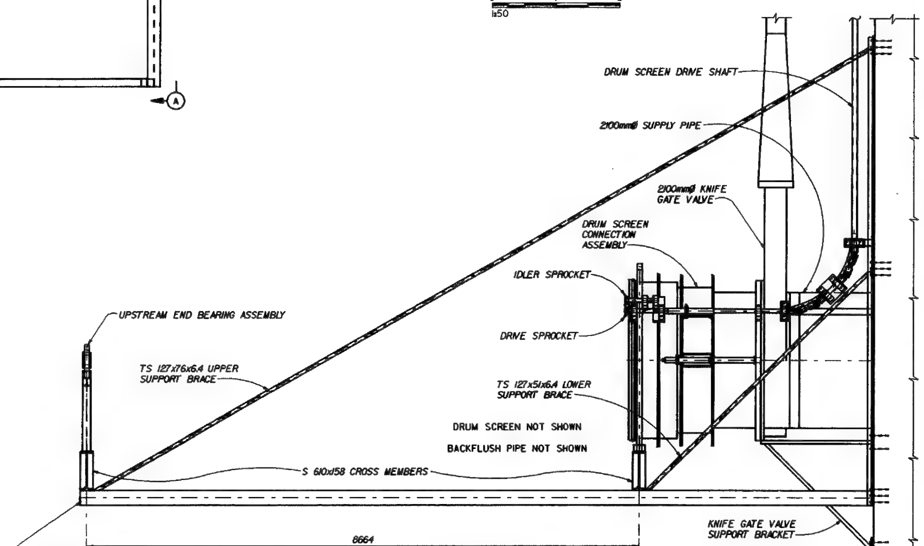
ELEVATION A

1:50



SECTION B

1:50



ELEVATION C

1:50

NOTES:

1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. ALL FERROUS SURFACES, EXCEPT STAINLESS STEEL, TO RECEIVE EPOXY PAINT SYSTEM.

US Army Corps of Engineers
Walla Walla District

Symbol	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.
MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

Designed by: K. RENSHAW, PE	Date: XXX	
Drawn by: K. RENSHAW, PE	Scale: AS SHOWN	
Checked by:	Dwg. No.: XX-B-XX	
Supervised by:	File No.:	
Chief, MECH SEC.	XXX	

CADD FILENAME:L:\usr7\cad\ew\1meswm22.dgn PLOT TIME:20-SEP-1999 08:35

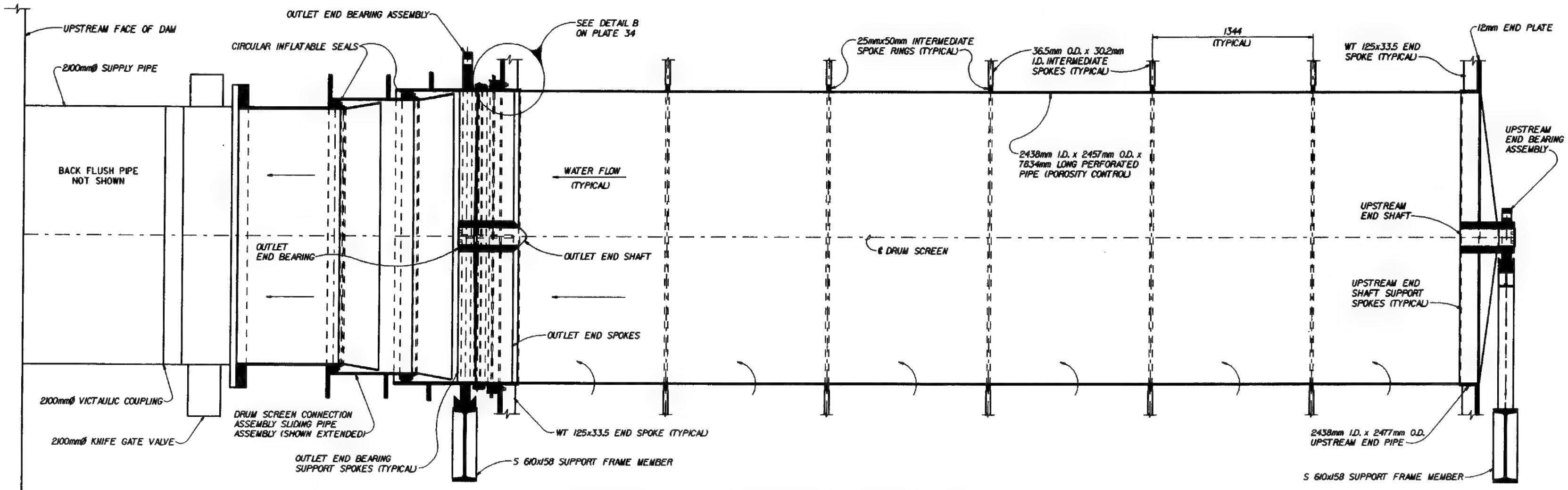
LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
DRUM SCREEN SUPPORT FRAME

Plate number: 35

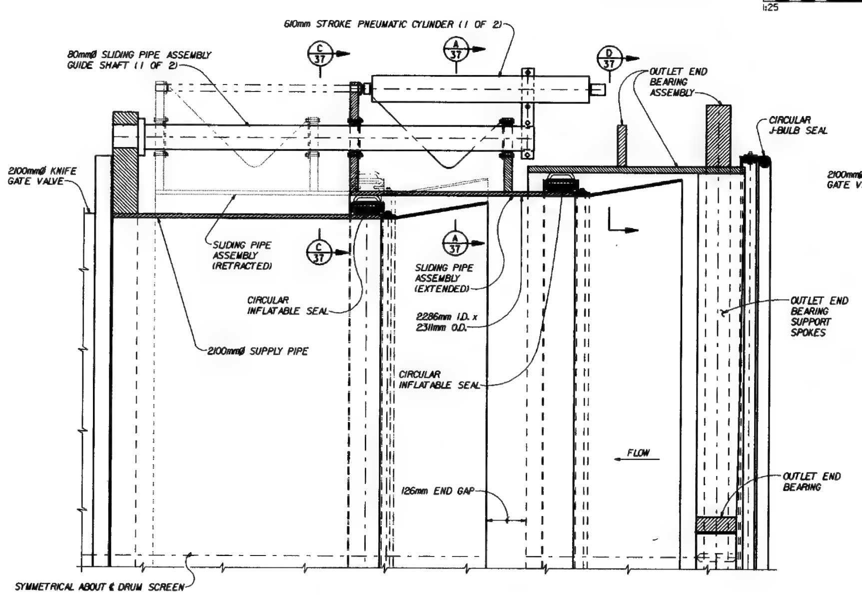
PEN TABLE ATTACHED: NO

SHEET MAIN SCALE: 50

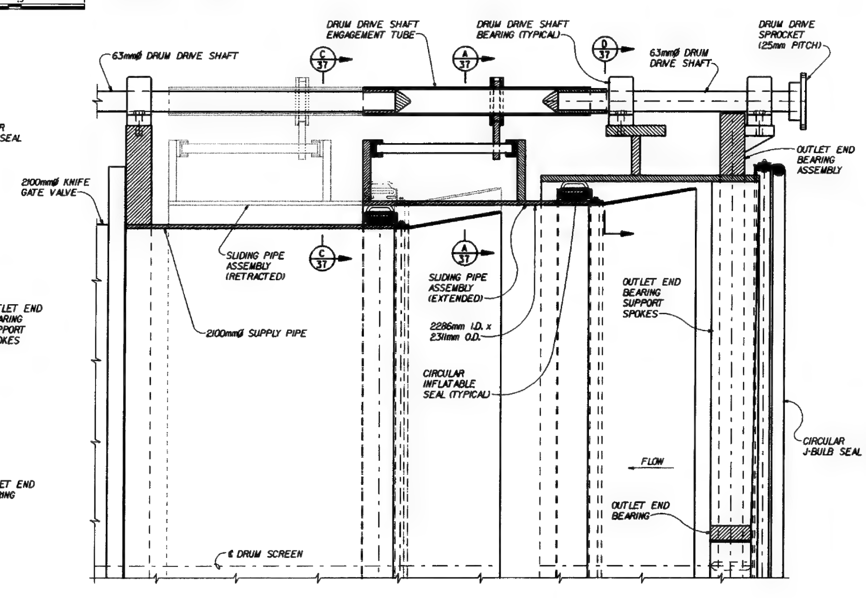
REFERENCE FILES: EAW BLK



LONGITUDINAL SECTION THROUGH CENTER OF DRUM SCREEN



SECTION THROUGH SLIDING PIPE ACTUATOR



SECTION THROUGH DRUM SCREEN DRIVE SHAFT

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.

US Army Corps of Engineers
Walla Walla District

Revision	Description	Date	Appr.

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.

MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

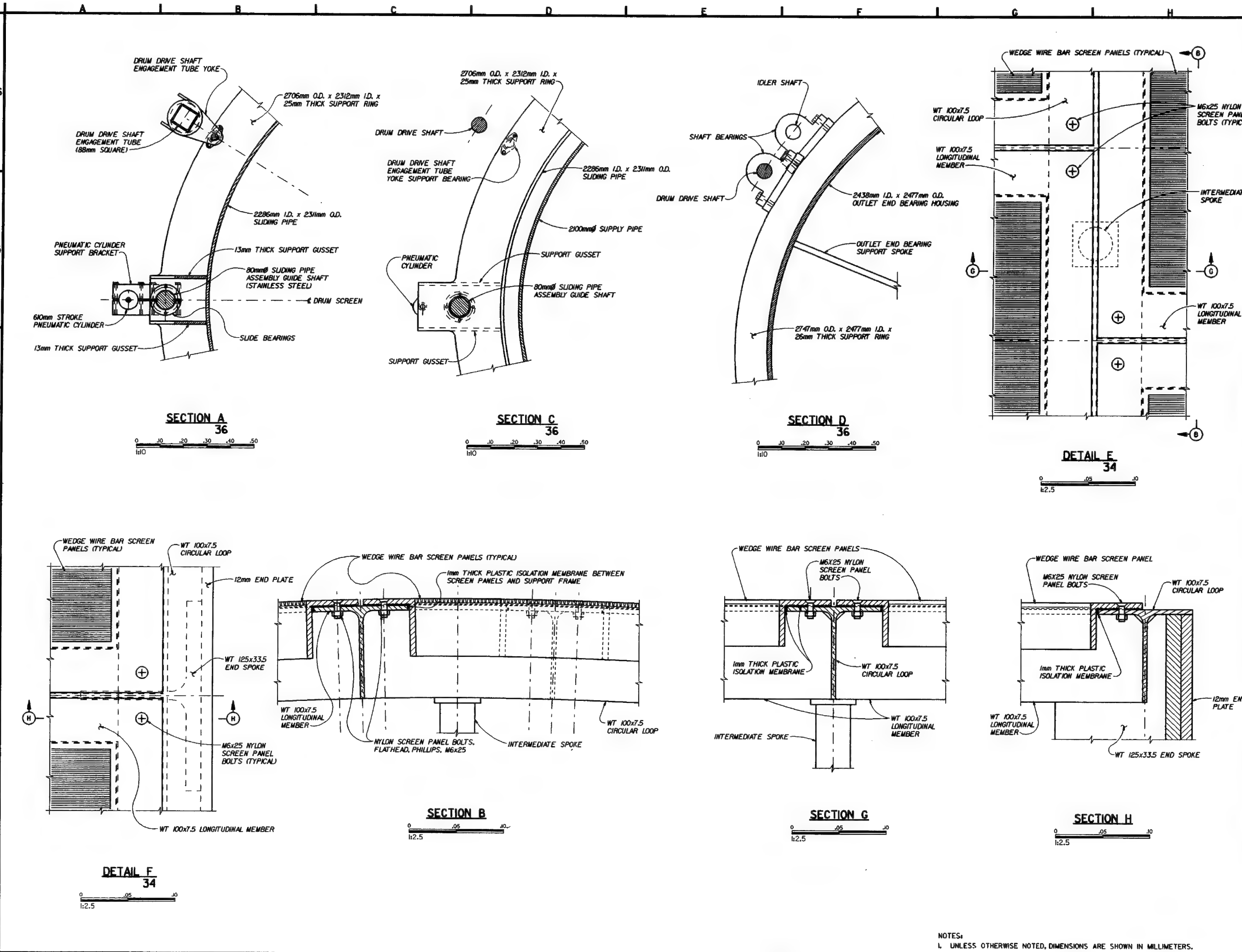
Designed by: K. RENSHAW PE	Date: XXX	
Drawn by: K. RENSHAW PE	Scale: AS SHOWN	
Checked by:	Inv. No.: XX-8-XX	
Supervised by:	File No.: XXX	
Chief, MECH SEC.		

CADD FILENAME:L:\usr7\cad\eaw\lmeawm23.dgn PLOT TIME:20-SEP-1999 08:34

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
DRUM SCREEN DETAILS I

Plate number: 36

PEN TABLE ATTACHED: LMEAWM23.HAF
REFERENCE FILES: EAW.BLK
SHEET MAIN SCALE: 25



NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.

US Army Corps of Engineers
Walla Walla District

Submitted by: Chief, Design Branch
Recommended by: Chief, Engineering Division
CONT. NO.
MICROSTATION SE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

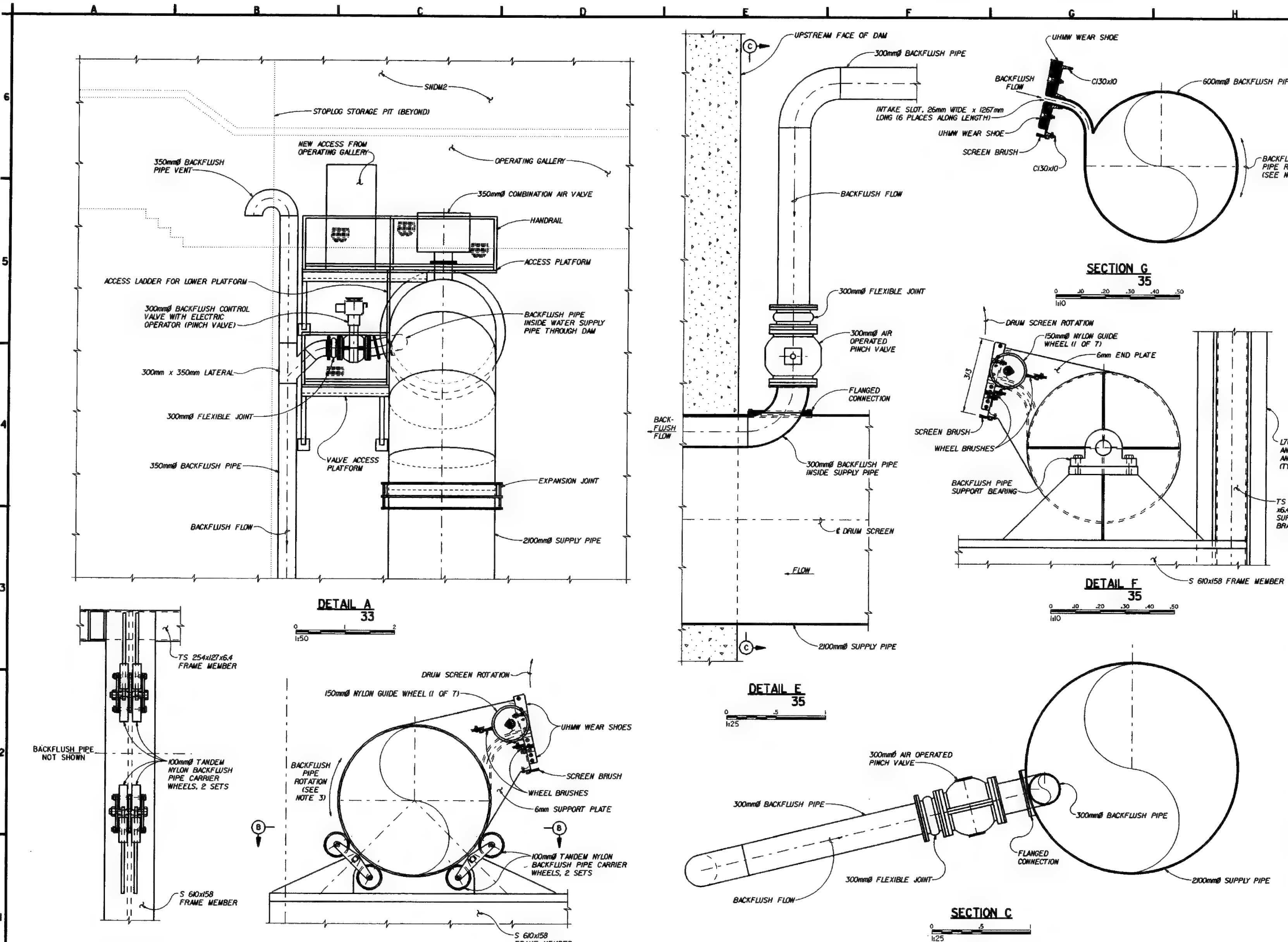
Designed by: K. RENSHAW PE	Date: XXX
Drawn by: K. RENSHAW PE	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by: Chief, MECH SEC.	File No.: XXX

CADD FILENAME:\usr7\cad\eaw\1meawm24.dgn PLOT TIME:20-SEP-1999 08:34

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
DRUM SCREEN DETAILS II

Plate number: 37

PEN TABLE ATTACHED: NO
SHEET MAIN SCALE: 10
REFERENCE FILES: EAW.BLK



NOTES:

1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. SEE PLATE 31 FOR LEGEND.
3. BACKFLUSH PIPE WOULD BE ROTATED ONLY DURING MAINTENANCE ACTIVITIES.

US Army Corps of Engineers
Walla Walla District

Submitted by:	CONT. NO.
Chief, Design Branch / Date	
Recommended by:	
Chief, Engineering Division / Date	

Designed by: K. RENSHAW, PE	Date: XXX	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS WALLA WALLA, WASHINGTON
Drawn by: K. RENSHAW, PE	Scale: AS SHOWN	
Checked by:	Inv. No.: XX-B-XX	
Supervised by:	File No.: XXX	
Chief, MECH SEC.		

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 2
GRAVITY SUPPLY SYSTEM
BACKFLUSH PIPE DETAILS

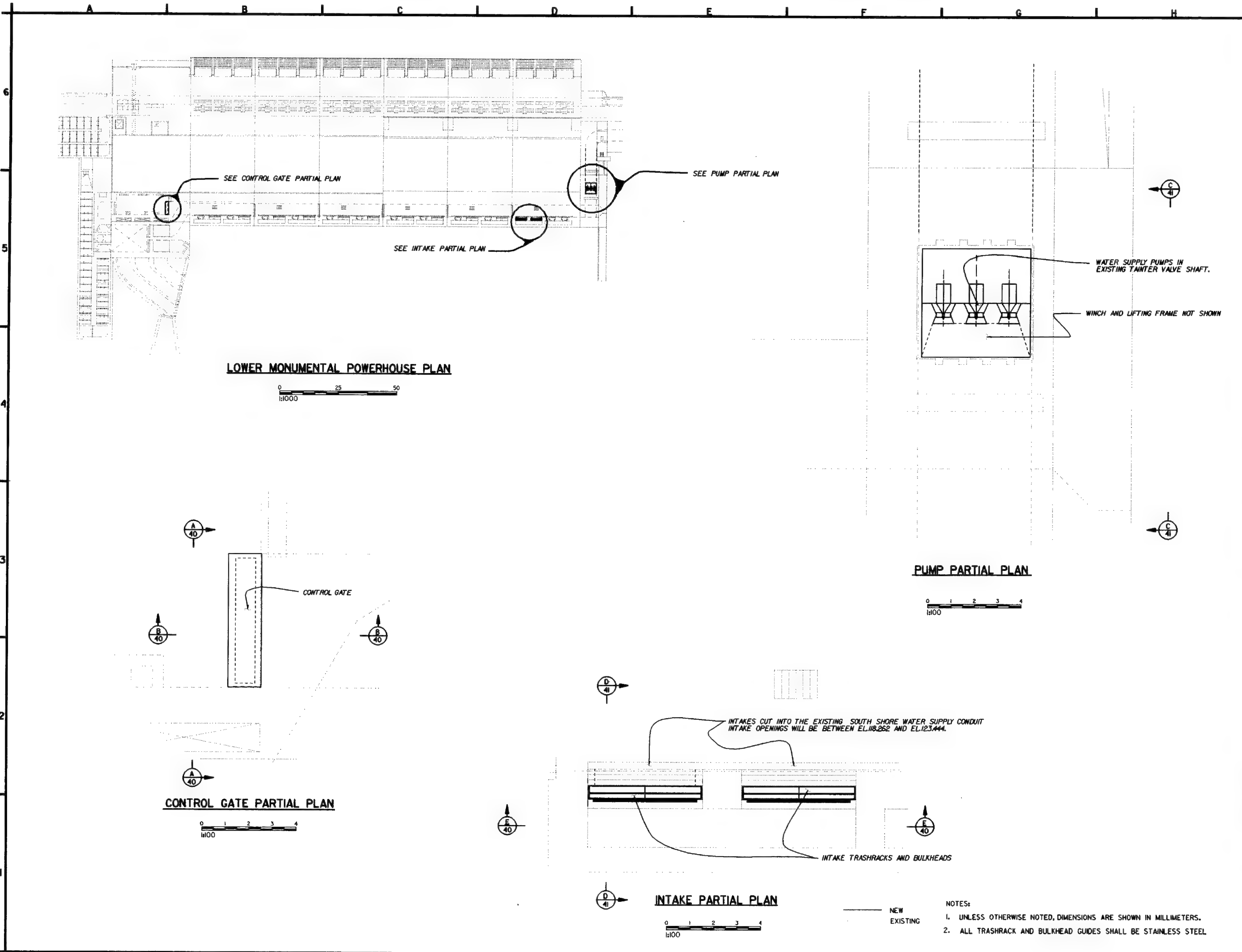
Plate number: 38

CADD FILENAME:L:\usr7\cad\ew\lmeawm25.dgn PLOT TIME:20-SEP-1999 08:33

MICROSTATION SE

PEN TABLE ATTACHED: LMEAWM25.HAF

SHEET MAIN SCALE: 50



NOTES:

1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. ALL TRASHRACK AND BULKHEAD GUIDES SHALL BE STAINLESS STEEL

US Army Corps of Engineers
Walla Walla District

Submitted by:
Chief, Design Branch
Recommended by:
Chief, Engineering Division
CONT. NO.
MICROSTATION SE

Designed by: LOWELAND
Drawn by: LOWELAND
Checked by:
Supervised by:
Chief, STRUCT. DES. SEC.

Date: XXX
Scale: AS SHOWN
Inv. No.: XX-B-XX
File No.: XXX

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

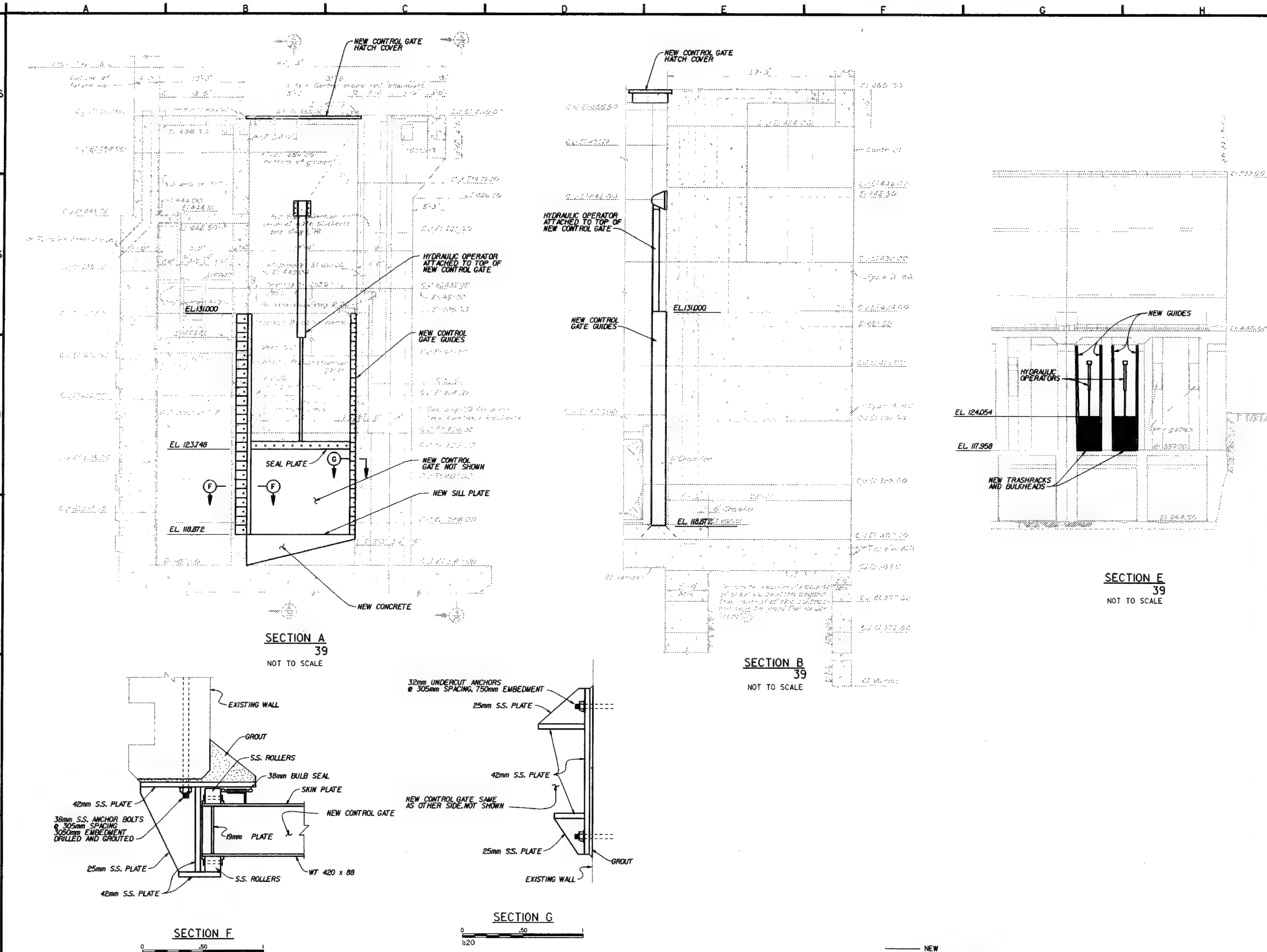
CADD FILENAME:L:\usr7\cad\eaw\lm39.dgn PLOT TIME:20-SEP-1999

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 3
INLINE PUMP SYSTEM
PLAN & SECTIONS

Plate number: 39

PEN TABLE ATTACHED: X

SHEET MAIN SCALE: 1:100



NEW
EXISTING

NOTES:
1. UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE SHOWN IN MILLIMETES

US Army Corps of Engineers
Walla Walla District

Submitted by:	
Chief, Design Branch	Date
Recommended by:	
Chief, Engineering Division	Date
CONT. NO.	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

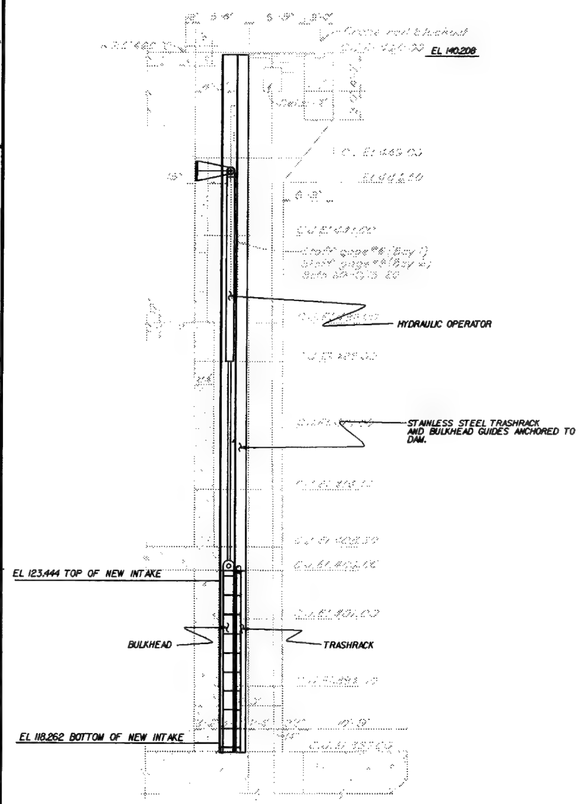
Designed by: LOWELAND	Date: XXX
Drawn by: SHENEFIELD	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, STRUCT. DES. SEC	

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 3
INLINE PUMP SYSTEM
SECTIONS

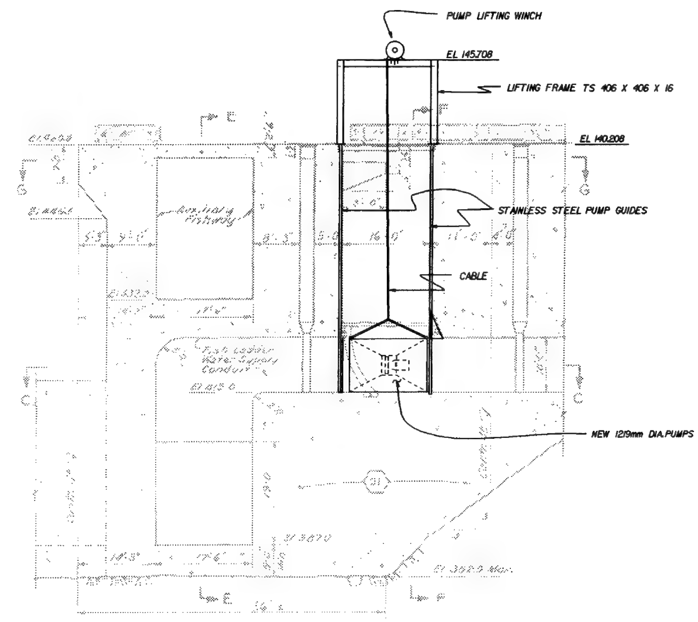
Plate number: 40

MICROSTATION SE
PLOT TIME: 20-SEP-1999 10:44
CADD FILENAME: L:\usr7\cad\eaw\lm40.dgn

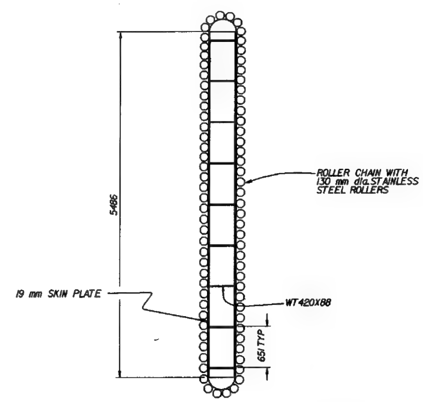
PEN TABLE ATTACHED: LM40.HAF
COLOR TABLE ATTACHED: PLTIRAS.CTB
REFERENCE FILES:
SHEET MAIN SCALE: 100:1



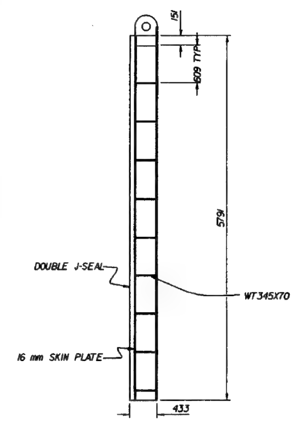
SECTION D
39
NOT TO SCALE



SECTION C
39
NOT TO SCALE

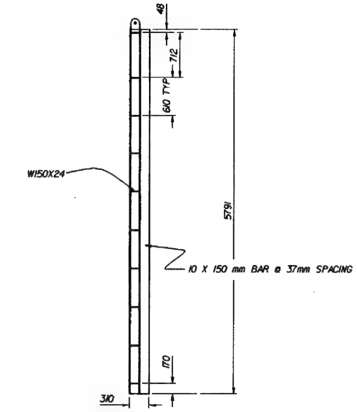


NEW CONTROL GATE ELEVATION



INTAKE BULKHEAD ELEVATION

——— NEW
- - - - EXISTING



INTAKE TRASHRACK ELEVATION

NOTES:
1. UNLESS OTHERWISE NOTED, DIMENSIONS ARE SHOWN IN MILLIMETERS.
2. ALL STEEL SHALL BE ASTM A36 UNLESS OTERWISE NOTED.

US Army Corps of Engineers
Walla Walla District

Submitted by:
Chief, Design Branch — Date
Recommended by:
Chief, Engineering Division — Date
CONT. NO.

Designed by: LOWELAND	Date: XXX
Drawn by: SHENEFIELD	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, STRUCT. DES. SEC	

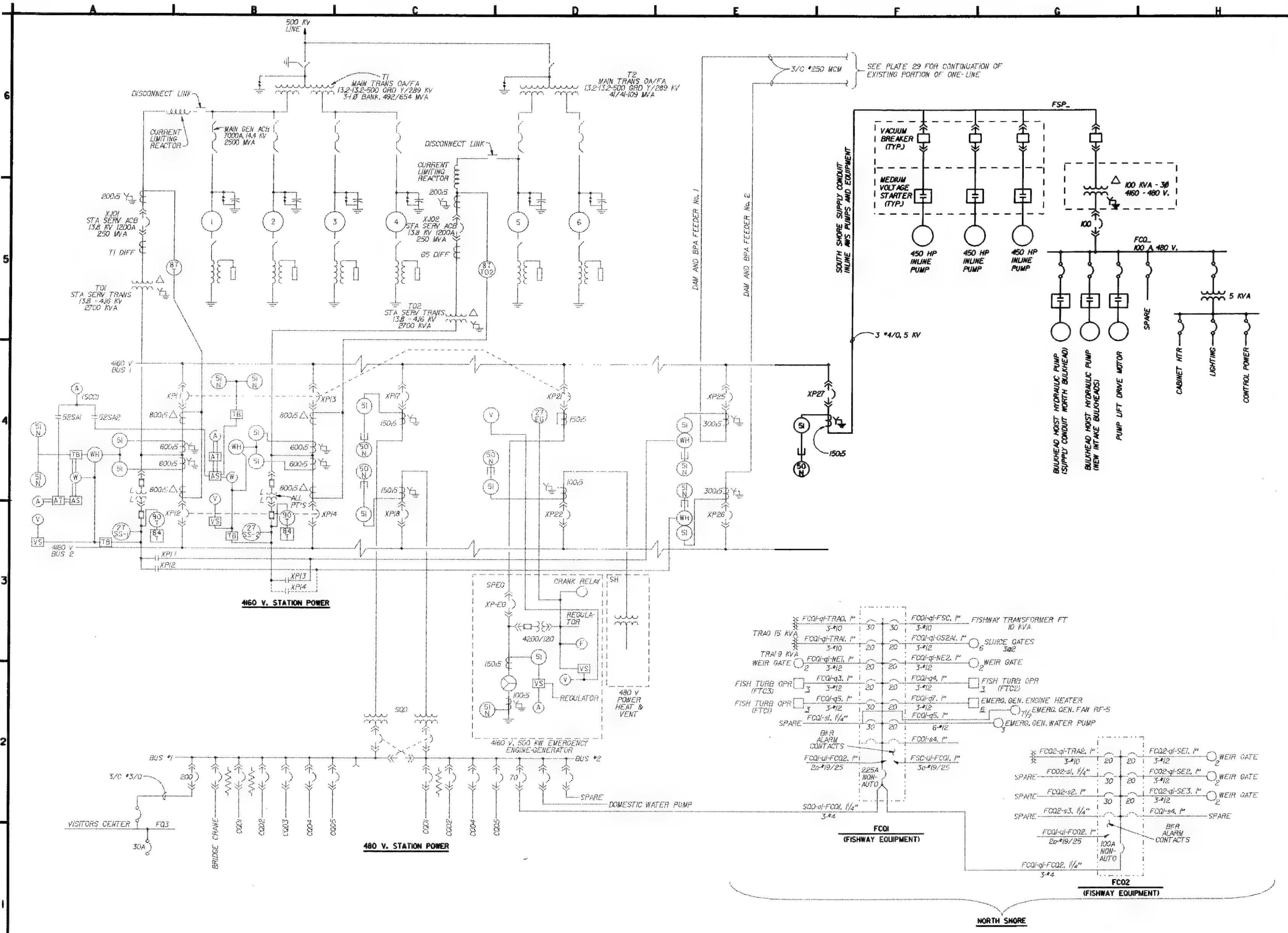
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 3
INLINE PUMP SYSTEM
PUMP AND INTAKE
SECTIONS & DETAILS

Plate number: 41

CADD FILENAME: L:\usr7\cad\eaw\lm41.dgn PLOT TIME: 20-SEP-1999 10:49 MICROSTATION SE

PEN TABLE ATTACHED: LM4LHAF COLOR TABLE ATTACHED: PLTRAS.CTB REFERENCE FILES: SHEET MAIN SCALE: 1:100



US Army Corps of Engineers
Walla Walla District

Revision	Description	Date	Appr.

Submitted by:
Chief, Design Branch Date
Recommended by:
Chief, Engineering Division Date

CONT. NO.

Designed by: DEWITT	Date: XXX
Drawn by: ROGERS	Scale: AS SHOWN
Checked by:	Inv. No.: XX-B-XX
Supervised by:	File No.: XXX
Chief, ELECT. DES. SEC.	

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
WALLA WALLA, WASHINGTON

LOWER SNAKE RIVER
SNAKE RIVER, OREGON, WASHINGTON AND IDAHO
EMERGENCY AUXILIARY WATER SUPPLY
LOWER MONUMENTAL LOCK AND DAM
ALTERNATIVE NUMBER 3
FISHWAY EQUIPMENT
ONE-LINE DIAGRAM

Plate number: 43

CADD FILENAME: L:\usr7\cad\eaw\iceawe43.dgn PLOT TIME: 17-SEP-1999 16:23 MICROSTATION SE

PEN TABLE ATTACHED: Iceawe27.hcf
REFERENCE FILES: EAW.BLK
SHEET MAIN SCALE: 1:1

APPENDIX A

Quality Control Plan

QUALITY CONTROL PLAN

Revised 3/1/99

PROJECT:	Other System Improvements I.D. 3.06.01.01	DATE QCP PREPARED:	4 Sept. 98
JOB TITLE:	Adult Fishway Emergency Water - Western Project	PREPARER:	Porter/Crum
TYPE OF DOCUMENT:	DM (Estimated Cost $xxx)	TYPE OF REVIEW:	Internal In-House
DESCRIPTION / SCOPE:	See Attached Documentation	BUDGET for REVIEW:	$ 6,960.00
DATE QC COMPLETED:		ACTUAL COST:	

PRODUCT TEAM

NAME	GRADE	DISCIPLINE	OFFICE SYMBOL
Kevin Renshaw PE	GS-12	Mechanical Engr.	ED-D-ME
Van DeWitt PE	GS-12	Electrical Engr	ED-D-EL
Dan Katz PE	GS-11	Hydraulic Engr	ED-D-HY
Dave Hurson	GS-12	Fish Bio/Ops	OD-TF
Karl Pankaskie	GS-12	Cost Engineer	ED-C
Jon Lomeland	GS-11	Structural Engr.	ED-D-ST
K. Crum R.A.	GS-12	Tech Manager	ED-D
J. Moyer P.E.	GS-13	Project Manager	PM-PJ

REVIEW TEAM

NAME	GRADE	DISCIPLINE	OFFICE SYMBOL	Availability Sect	Availability Branch
Chuck Palmer, PE	GS-12	Mechanical Engr.	ED-D-ME	OK	
Cary Rahn, PE	GS-12	Electrical Engr	ED-D-EL	OK	
Lynn Reese, PE	GS-12	Hydraulic Engr/Lead	ED-D-HY	OK	
John McKern	GS-13	Fish Bio/Ops	OD-TF		OK
Jesus Barrios	GS-12	Cost Engineer	ED-C		OK
Bruce Collison	GS-12	Structural Engr.	ED-D-ST	OK	

MAJOR PRODUCT MILESTONES ITEM	DATE	IN-PROGRESS REVIEWS	DATE
Auxilary Water Supply - Technical Report - HLD/LMA (Western Projects)			
Complete 60% Western Project portion of DM	15-Aug-98		
		Kickoff Tech Review of 60% DM document	14-Sep-98
		Complete 60% TR and submit comments	30-Nov-98
		60% Review Meeting	30-Nov-98
		Incorporatre 60% comments	30-Dec-98
Complete 90% Western Project portion of DM	15-Mar-99		
Complete 90% TR and submit comments	01-Apr-99		
90% Review Meeting	10-Apr-99		
Complete 100% draft document - Western Projects	TBD		
Auxilary Water Supply - Technical Report - LGO/LGR (Eastern Projects) Schedule TBD			

DISTRICT APPROVAL by ________

STATEMENT OF TECHNICAL [redacted] REVIEW

COMPLETION OF INDEPENDENT TECHNICAL REVIEW:

The Walla Walla District Engineering Division has completed the in-house technical review for the Lower Snake River - Ice Harbor and Lower Monumental Locks and Dams, Adult Fishway Systems Emergency Auxiliary Water Supply, Phase II – Technical Report. Notice is hereby given that an independent technical review (ITR) has been conducted, that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the ITR, compliance with established policy principles and procedures utilizing justified and valid assumptions was verified. This included: review of assumptions methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customers' needs consistent with law and existing Corps policy. The ITR was accomplished by an independent district review team identified below:

Lynn Reese — 8/31/99

Technical Review Team Leader — Date

Review Team Members

CERTIFICATION OF INDEPENDENT TECHNICAL REVIEW:

Technical concerns and the explanation of the resolution are attached:
As noted above, all concerns resulting from the independent technical review of the project have been considered.

N/A
Chief, Planning Division

Chief, Engineering Division — 9/7/99

N/A
Chief, Operations Division

N/A
Chief, Real Estate Division

APPENDIX B

Technical Review Comments

Review Comments

Project: Auxiliary Water Supply – Ph. II Tech. Rept. Location: Ice Har. / Low. Mon.

XX NWWEN-ED-D-HY __ Air Force __ Army auxwoct.doc	**Design Document** __ D. Memo __ P&S __ Prlim. XX 60 % Tech. Review	**Discipline** __ Concept XX Hydr. Design __ Civil __ Final __ Mech/Elect. Structural	**REVIEW CONFERENCE** A-comment accepted W-comment withdrawn (if neither, explain)	**DESIGN OFFICE** C-correction made (if not, explain)	Back Check By (initials)
Date: 18 June, 1999	Reviewer: Lynn Reese	Telephone: 509-527-7531		Page 1 of 2	

Item No.	Drawing Sht. Spec. Para.	COMMENTS	Action taken on Comments by:		
1.	2.02. (and other Oper. Criteria places)	Insure that biologist have a clear understanding of what the hydraulic conditions will be for the different criteria / target conditions given in the report for the different alternatives suggested. (For example, saying that a 2-foot head differential at a fishway entrance under low tailwater conditions would meet criteria may not be correct since channel velocities upstream of the weir may be too high).	A. The wording of section 2.02 has been changed to refer to a new section 1.08 (Summary of Adult Passage Hydraulic Criteria). Only alternative 1 requires a change in criteria. The other alternatives meet existing criteria, stated in section 1.08.		L.R
2.	Section 2.03.a., pg. 8-10	I'm somewhat apprehensive regarding Alternative 1 which would use two pumps during normal operation and the third pump as a backup. I do like the idea and it appears it might be feasible. However, before saying that this option is judged to be acceptable, there are a few more issues / questions that should be checked: - Under Section 2.03.a.(1).(b), insure that the suggested 540 cfs is acceptable as a minimum flow. Besides considering submergence and weir water differential requirements, be sure to evaluate / get biological buy-in as it relates to upstream channel velocities and "mass of flow" judgements related to flow quantity coming out of an entrance. - Is the entrance weir head shown in Table 2-1 a water differential or an energy head differential? At lower tailwater elevations, predicted discharge over the weir based on WES model data and their "delta h" value could be significantly different than that shown. (Note: Make sure that everyone has the same definition of "Entrance Weir Head" as it relates to fishery criteria). - It makes sense that at lower tailwater elevations / weir heights, the weir discharge coefficient will be higher and therefore will pass more flow given the same submergence and water differential. Thus, for identical conditions at lower tailwater versus higher tailwater elevations, it will require less water differential to pass the flow. If I'm understanding this correctly, what you are saying is that instead of having (for example) a 1.0 foot-head water differential to pass a given flow, it would be less than 1-foot. Make sure everyone understands this as it relates to fishery criteria.	A	The entrance weir head shown in Tables 2-1 and 2-4 refers to the water differential across the weir. However, the weir discharge shown in those tables does take into account corrections based on flow velocity. The information was presented in this way because the fishery criteria calls for a 1.0 ft minimum water differential across the weir, yet it is also necessary to present the actual discharge, accounting for flow velocity.	L.R

Review

Comments

Project:\Auxiliary Water Supply – Ph. II Tech. Rept. Location: Ice Har. / Low. Mon.

XX NWWEN-ED-D-HY __ Air Force __ Army auxwoct.doc	**Design Document**: __ D. Memo, __ P&S, __ Prlim., XX 60 %, __ Final, Tech. Review	**Discipline**: __ Concept, XX Hydr. Design, __ Civil, __ Mech/Elect., Structural	**REVIEW CONFERENCE** A-comment accepted W-comment withdrawn (if neither, explain)	**DESIGN OFFICE** C-correction made (if not, explain) / Back Check By (initials)
Date: 18 June, 1999	Reviewer: Lynn Reese	Telephone: 509-527-7531		Page 2 of 2

Item No.	Drawing Sht. Spec. Para.	COMMENTS	Action taken on Comments by:	
3.	Section 2.03.c.(2)., Pg.17	Will there be a VE study completed on final screen intake designs? Depending on which one of these options are selected (if any), it may be possible to fine-tune designs / reduce costs. (For example, the flat intake screen design shown on Plate 16 might be done differently using porosity plates and fewer valves). Depending on the design, a hydraulic model study (physical or numeric) may also be required to insure that screen design criteria is not exceeded.	A. I'm sure there will be. Personally I don't have much faith in model studies. It seems the final result ends up being trial and error in the field to get something fine-tuned. Using the valves would allow easy adjustment without changing out multiple versions of perforated plates.	L.R
4.	Section 2.03.a.(b), pg. 9	The head differential across a fishladder weir is to be increased by about 0.2 feet. At one of the fishladders in the past (I think at Ice Harbor), there was a situation where a few tenths increase in ladder weir differentials resulted in a dangerous structural loading situation of harmonic waves. Insure that any new fishladder weir water differential does not approach that which created past problems.	A. This potential problem applies to alternative 1, which is not recommended in the final draft. Therefore, since the alternative was rejected for other reasons, the possibility of harmonic waves in the fish ladder was not investigated.	L.R
5.	Section 3.04.b.(2), pg. 32, 33, and 34	I'm having a hard time following hydraulic details of the drum screen backflush system. It states on pg. 34 that reservoir head would be used to drive the backflush system, but I'm not sure that I see it. I need additional clarification.	A. The design is too simple. Water goes from the reservoir through the screen in one direction and then turns around and drains back through the screen in the opposite direction as it goes into the backflush pipe. From there it goes onto the supply channel. Thus the summary statement "Reservoir head would be used to drive the backflush system." Plate 38 and other plates show this. Flow direction arrows will be added to help show this better.	L.R

Review Comments

60-tr-collison

Project: AUXILIARY WATER SUPPLY Location: IH &LO MO

Date: 11/09/98 Reviewer: Bruce Collison Telephone: 527-7551

X NPW-EN-DB-ST
__ Air Force
__ Army

Design Document		Discipline
D. Memo	Concept XX	Structural
P&S	Prlim.	Design
60% XX	Final	

REVIEW CONFERENCE: A-comment accepted, W-comment withdrawn (if neither, explain)

DESIGN OFFICE: C-correction made (if not, explain)

Item No.	Drawing Sht. Spec. Para.	COMMENTS	Action taken on Comments by: REVIEW CONFERENCE	DESIGN OFFICE	Back Check By (initials)
1	page 16	Would the intake for the gravity flow systems attract juveniles? This might be a problem.	A	Its possible that it could attract juveniles, but the screen openings are small enough to keep them from being drawn into the system.	
2	Plate 4	Will the bulkhead allow dewatering of the structure? The structure may not have been designed for this. Stability and unbalance water loads on the walls should be considered.	A	The structure is designed to be unwatered, the new bulkheads are only to isolate individual pumps the current bulkheads can not isolate each pump for maintenance purposes.	
3	Plate 11	Any selected method should include a consideration of seismic effects upon the existing nonoverflow section. However, the effects are probably minor.		If one of these methods is selected, we can perform an analysis during plans and specs.	
4.	Plate 7	The unbalanced load on the wall will transfer bending into the slab at the top of the channel. Additional postensioning may be required there.	A	More analysis will be performed.	

Review Comments

60-tr-collison

Project: AUXILIARY WATER SUPPLY   Location: IH &LO MO

Date: 11/09/98   Reviewer: Bruce Collison   Telephone: 527-7551

X NPW-EN-DB-ST
__ Air Force
__ Army

Design Document		Discipline
D. Memo	Concept XX	Structural
P&S	Prlim.	Design
60% XX	Final	

Item No.	Drawing Sht. Spec. Para.	COMMENTS	REVIEW CONFERENCE A-comment accepted W-comment withdrawn (if neither, explain)	DESIGN OFFICE C-correction made (if not, explain)	Back Check By (initials)
			Action taken on Comments by:		
	Plate 7	Is there a loading scenario may cause this structure to want to float, slide or overturn? This may include seismic with unbalanced head.	A	The structure is ok for overturning.	
6	Plate 7	Will there be a loading scenario that causes the walls or slabs in this structure to become overstressed?	A	Will perform further analysis.	
8	Plate 15	What carries the weight of the in-line sleeve valve? Is the existing structure adequate to carry these loads?	A	If this method is selected, we can perform an analysis during plans and specs.	
9	Plate 35	Can this be used for Ice Harbor for temporary caisson option?	A	Possibly	
10	Plate 32	Any selected method should include a consideration of seismic effects upon the existing nonoverflow section. However, the effects are probably minor.	A	If this method is selected, we can perform an analysis during plans and specs.	
11	Plate 24	It appears the toe of the nav-lock monolith will be trimmed. The effects on stability of this monolith would have to be investigated.	A	There will be no trimming of the monolith.	

Revie Comments Project: Emergency Auxiliary ter Supply Location: Ice Harbor/Lower Monum Dams

Office	Design Document Stage	Disc ne	REVIEW CONFERENCE	DESIGN OFFIC	Back Check By
CENWW-ED-D-EL	Technical Review	Electrical	A-comment accepted W-comment withdrawn (if neither, explain)	C-correction made (if not, explain)	(initials)

Date: 11/02/98 Reviewer: C. Rahn Telephone: 509-527-7564

Action taken on Comments by:

Item No.	Drawing Sht. Spec. Para.	COMMENTS	REVIEW CONFERENCE	DESIGN OFFICE	Back Check By
1.	TR 1.01 Page 1	The acronym BI-OP should be included in parenthesis in the 1st sentence before being used later in the paragraph.	A	C	CR
2.	TR 1.07 b. Page 3	Provide criteria used to establish what makes arrangements "not conducive to 100% backup". Rationale needs to be objective and not solely subjective.	A	C-Reworded	CR
3.	TR 2.0з a. (2) Page 11	Any consideration of operating with the tie breaker open, keeping both buses completely isolated and only operating on a single bus via the tie breaker under emergency situations?	This is an Operational Decision and can be operated either way.	C-Added a statement about operating options	CR
4.	TR 2.03 c.(2)b Page 18	Was operation of the backflush pump considered? Text states only one screen to be backflushed at a time. Will the pump be started and stopped 36 times to complete a cleaning cycle, or will the pump be dead-headed while knife gates are opened and closed?	A	Pump would operate continuously, valves would be opened before closing the previous one.	CR
5.	TR 2.05 a Page 24	Last sentence in 2nd paragraph. Not sure this is necessary, states the obvious.	A	C	CR
6.	TR 2.05 a Page 24	General comment on use of solid state starters. Consider supplying bypass contactors to remove the solid state components from the system after soft start. This will increase the life of the solid state devices, reduce heat rejection to the pump rooms, and reduce harmonics induced on the electrical system by the firing of the solid state devices.	A	C	CR
7.	Plates 3, 18, 20	List motor loads in SI units to be consistent with the report format.	A	C	CR
8.	Plates 3, 18, 20	Not sure that screening of existing one-line is warranted. Just makes the print hard to read. New work is shown enclosed in dash boxes.		The screening clarifies what is existing.	CR
9.	Plates 3, 18	Callout run lengths of cable in meters not MM.	A	C	CR
10,	Plate 3	Correct spelling of "TYE" Breaker.	A	C	CR
11,	Plate 18	List voltage class of the switchboards for the 3 options fed from LSQ1.	A	C	CR
12,	Plate 20	List conduit sizes in SI units to be consistent with the report format.	A	C	CR
13.	Plate 20	Somewhat confusing to show the FSQ1 switchboard connected to both the existing and revised 1-Lines of FSP1.	A	C	CR

Revie omments   Project: Spillway Deflect   Location: Ice Harbor Da roject

Office		Design Document Stage	Discipline	REVIEW CONFERENCE	DESIGN OFFIC	Back Check By
CENPW-EN-DB-EL		Technical Review	Electrical	A-comment accepted W-comment withdrawn (if neither, explain)	C-correction made (if not, explain)	(initials)
Date: 11/02/98	Reviewer: C. Rahn	Telephone: 509-527-7564				Page 2 of 2
Item No.	Drawing Sht. Spec. Para.	COMMENTS		Action taken on Comments by:		
14.	General	I did not see any discussion on how auxiliary water systems can or are to remain functional if major renovations to the electrical distribution systems are made.		A	C-Added discussion; Cannot remain operational during electrical renovations.	CR

Tech Review

Comments Project: Auxiliary Water Supply – Ph II Tech Report Location: Ice Harbor/Lo Mo

Date: 11/09/98 Reviewer: C. Palmer Telephone: 527-7571

X NPW-EN-DB-ME
__ Air Force
__ Army

Design Document
__ D. Memo __ Concept
__ P&S __ Prelim.
X 60% __ Final

Discipline
__ Arch.
__ Civ.
X Mech
__ Struct.

Item No.	Drawing Sht. Spec. Para.	COMMENTS	REVIEW CONFERENCE: A-comment accepted, W-comment withdrawn (if neither, explain)	DESIGN OFFICE: C-correction made (if not, explain)	Back Check By (initials)
			Action taken on Comments by:		
1	1.01	The statement regarding the requirement for emergency water supplies states "…where determined…. to be necessary". Need to include criteria defining this need. History of failures or interruptions in operation for instance. Unless criteria have changed the systems should be adequate as originally designed.	A	We are addding backup because someone is afraid something might fail.	CRP
2	2.03.a & 2.03.a.1.b	Alternative 1 contradicts current operating criteria discussed in 2.02.c. This alternative should not be considered.	A	C. Will restate to clarify that it does not always satisfy criteria. However, since this alternative shows what the current system could produce without major changes, it will provide a useful comparison against the alternatives that do fully meet the specified criteria.	CRP
3	Ice Harbor North Shore	By providing redundant pumping systems is the need for a dedicated fish pump crane required? Keep in mind there is scheduled down time annually on these systems for maintenance. That seems like a large expense providing for a case where there is a compound problem, that is – two pumps go out within the same operating season.		Providing a crane allows for quicker repairs thus increasing the reliability of the system.	CRP
4	2.03.c.2.a	How is the tee screen isolated for removal? Need to discuss how the flow is shut down or isolated allowing screen removal for maintenance.	A	Will add description to the text.	CRP

Tech Review

Comments Project: Auxiliary Water Supply – Ph II Tech Report Location: Ice Harbor/Lo Mo

Date: 11/09/98 Reviewer: C. Palmer Telephone: 527-7571

X NPW-EN-DB-ME
__ Air Force
__ Army

Design Document: __ D. Memo, __ P&S, X 60%, __ Concept, __ Prelim., __ Final

Discipline: __ Arch., __ Civ., X Mech, __ Struct.

REVIEW CONFERENCE: A-comment accepted, W-comment withdrawn (if neither, explain)

DESIGN OFFICE: C-correction made (if not, explain)

Back Check By (initials)

Item No.	Drawing Sht. Spec. Para.	COMMENTS	Action taken on Comments by: Review Conference	Design Office	Back Check By
5	2.04.a	In the third paragraph we need to mention the use or "non-use" of the powerhouse floating orifices.	A	Some of the orifices are used.	CRP
6	2.04.a	Water from Juvenile Fish Primary Dewatering is included in the adult attraction flow in this section. I believe the Juvenile Facility isn't operating the entire time the adult is which would cause a lack of flow for the adult system during these periods	A	C. There are six weeks per year during which the adult system is operating with no flow from the juvenile facility. However, there is enough flow without it, unless a pump is off. In this event, the juvenile system could be restarted, and the flow it provides would be restored. Text will be changed to clarify this.	CRP

Tech Review

Comments Project: Auxiliary Water Supply – Ph II Tech Report Location: Ice Harbor/Lo Mo

Date: 11/09/98		Reviewer: C. Palmer Telephone: 527-7571			
X NPW-EN-DB-ME __ Air Force __ Army		**Design Document**: __ D. Memo, __ P&S, X 60%, __ Concept, __ Prelim., __ Final **Discipline**: __ Arch., __ Civ., X Mech, __ Struct.	**REVIEW CONFERENCE** A-comment accepted W-comment withdrawn (if neither, explain)	**DESIGN OFFICE** C-correction made (If not, explain)	Back Check By (initials)
Item No.	Drawing Sht. Spec. Para.	COMMENTS	Action taken on Comments by:		
7	3.02.a	Reword the first sentence, saying there is a "gravity supply system from the turbines" is misleading.	A	Text needs to be reworded. The fishwater turbine discharge does go into the supply conduit, but what we were really talking about was gravity flow down the fish ladder.	CRP
8	3.02.a	Again, I don't believe the juvenile facility operates during the entire time the adult system, therefore question as to whether the juvenile flow can be considered in the adult flow requirements.	A	See response to 6. Above.	CRP
9	3.03.a	State how much attraction flow is provided to the south shore by the turbine pumps, this figure becomes significant in later discussions.	A	The amount of flow provided by the north shore turbine pumps to the south shore varies depending on tailwater, forebay, pump head, wicket gate opening, and penstock flow. This discharge can be estimated if the particular set of conditions referred to in this comment is clarified.	CRP

Tech Review

Comments Project: Auxiliary Water Supply – Ph II Tech Report Location: Ice Harbor/Lo Mo

Date: 11/09/98 Reviewer: C. Palmer Telephone: 527-7571

X NPW-EN-DB-ME
__ Air Force
__ Army

Design Document: __ D. Memo, __ P&S, X 60%, __ Concept, __ Prelim., __ Final

Discipline: __ Arch., __ Civ., X Mech, __ Struct.

REVIEW CONFERENCE: A-comment accepted, W-comment withdrawn (if neither, explain)

DESIGN OFFICE: C-correction made (if not, explain)

Item No.	Drawing Sht. Spec. Para.	COMMENTS	Action taken on Comments by: Review Conference	Design Office	Back Check By (initials)
10	3.04.a.1	Discuss the reliability or increased capacity/redundancy of the North Shore system after it's been isolated.	A	There is a discussion in the second paragraph on page 32 that could possibly be relocated.	CRP
11	3.04.b.1	Clarify as to whether the 700 cfs is the gravity flow for the South shore only or sized for the entire system.	A	The first 2 paragraphs on page 32 should cover this pretty well.	CRP

Technical Review Comments

rpestcmts.doc

Project: IH LMO Auxiliary Water Supply Phase II Report

Location: Snake River Wash.

Date: 07/13/99		**Reviewer: Ron Porter** 527-7519 **Telephone:**			Page 1 of 1
Office NWW--EN		**Type of Design Document** D. Memo X Technical Report P&S 100% Prelim. 30%,60%,90% Final **Discipline** Cost Engr.		**DESIGN OFFICE** C-correction made (if not, explain)	Back Check By (initials)
Item No.	Drawing Sht. Spec. Para.	**COMMENTS**	Action taken on Comments by:		
1	Pg. 14 (8)	Since Alt #1 is the lowest cost alt., the conclusion para. should have more than a one sentence reason for not selecting this alt.	A. Renshaw	C	RP
2	Pg. 28 Table 2-6	Selected alt. #2 does equal the estimate plus 25% contingency, but the sub-feature subtotals do not match the estimate plus contingency in all cases.	A. Renshaw	C	RP
3	Pg. 29 par d. & APP A	The schedule to perform the work in Para d. does not agree with the dates in APP A. for IH NorthShore. Suggest changing Effect. Pricing Level and all Feature mid-point dates. Changes will affect fully funded cost.	A. Pankaskie	C	RP
4	Pg. 27, 35 & 52 par b.	"A detailed MCACES estimate" is **not** in APP A, B or C, for the alts. only the Total Contract Cost Summary sheets.	A. Renshaw	C	RP
5	Pg. 35 par d. & APP B	The schedule to perform the work in Para d. does not agree with the dates in APP B. for IH SouthShore. Suggest changing Effect. Pricing Level and all Feature mid-point dates. Changes will affect fully funded cost.	A. Pankaskie	C	RP
6	Pg. 53 par d. & APP C	The schedule to perform the work in Para d. does not agree with the dates in APP C. for Lower Monumental. Suggest changing Effect. Pricing Level and all Feature mid-point dates. Changes will affect fully funded cost.	A. Pankaskie	C	RP

APPENDIX C

Total Project Cost Summaries – Recommended Alternatives

SUBTOTAL - CONTRACTS - ALT 2, NORTH SHORE

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: ICE HARBOR LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

		CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99				AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99			........FULLY FUNDED ESTIMATE........			
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	SPENT THRU FY 99 ($K)	COST ($K)	CNTG ($K)	FULL ($K)
04.1--	DAM, ALT 2, NORTH SHORE GOVERNMENT FURNISH SERVICES	3,838	960	25%	4,798	3,838	960	4,798		4,145	1,037	5,182
	TOTAL CONSTRUCTION COSTS ====>	3,838	960	25%	4,798	3,838	960	4,798		4,145	1,037	5,182
01---	LANDS AND DAMAGES											
18---	CULTURAL RESOURCES											
21---	RECONNAISSANCE STUDIES											
22---	FEASIBILITY STUDIES											
30---	PLANNING, ENGINEERING & DESIGN	948	237	25%	1,185	948	237	1,185		997	247	1,244
31---	CONSTRUCTION MANAGEMENT	556	139	25%	695	556	139	695		601	151	752
	TOTAL PROJECT COSTS ====>	5,342	1,336	25%	6,678	5,342	1,336	6,678		5,743	1,435	7,178

THIS TPCS REFLECTS A PROJECT COST CHANGE OF $

DISTRICT APPROVED:

DISTRICT APPROVED DATE: 9 / 23 / 99

TOTAL FEDERAL COSTS ==============> 7,178

TOTAL NON-FEDERAL COSTS ==========>

THE MAXIMUM PROJECT COST IS =======> $

DIVISION APPROVED:

DIVISION APPROVED DATE: ____/____/____

CHIEF, COST ENGINEERING, Kim Callan

CHIEF, REAL ESTATE, Richard Carlton

CHIEF, PLANNING, Dennis Cannon

~~CHIEF,~~ ENGINEERING, Surya Bhamidipaty

CHIEF, OPERATIONS, Wayne John

CHIEF, CONSTRUCTION, John Treadwell

CHIEF, CONTRACTING, Jackie Anderson

PROJECT MANAGER, Kevin Crum

CHIEF, PM-PB, George Veighey

cnt (par) 9/23/99 CHIEF, PPPMD, James Waddell

____________ CHIEF, COST ENGINEERING, Wally Brassfield

____________ DIRECTOR, REAL ESTATE, Cynthia Brown

____________ DIRECTOR OF PROGRAM MANAGEMENT, Mike White

____________ DIRECTOR OF ENGINEERING & TECHNICAL SERVICES, Jim Crews

____________ CHIEF, CIVIL PROGRAMS, Clyde Barnhill

Walla Walla District

NOTE: Valid only when completely signed.

SUBTOTAL - CONTRACTS - ALT 1, SOUTH SHORE

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: ICE HARBOR LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99 COST ($K)	CNTG ($K)	TOTAL ($K)	FULLY FUNDED ESTIMATE SPENT THRU FY 99 ($K)	COST ($K)	CNTG ($K)	FULL ($K)
04.1--	DAM, ALT 1, SOUTH SHORE GOVERNMENT FURNISH SERVICES	1,484	371	25%	1,855	1,484	371	1,855		1,687	422	2,109
	TOTAL CONSTRUCTION COSTS ====>	1,484	371	25%	1,855	1,484	371	1,855		1,687	422	2,109
01---	LANDS AND DAMAGES											
18---	CULTURAL RESOURCES											
21---	RECONNAISSANCE STUDIES											
22---	FEASIBILITY STUDIES											
30---	PLANNING, ENGINEERING & DESIGN	383	96	25%	479	383	96	479		405	101	506
31---	CONSTRUCTION MANAGEMENT	216	54	25%	270	216	54	270		245	61	306
	TOTAL PROJECT COSTS ====>	2,083	521	25%	2,604	2,083	521	2,604		2,337	584	2,921

THIS TPCS REFLECTS A PROJECT COST CHANGE OF $ ~~~ ~~~~~ ~~~~~~~~

DISTRICT APPROVED:
DISTRICT APPROVED DATE: 9 / 23 / 99

TOTAL FEDERAL COSTS ===============> 2,921
TOTAL NON-FEDERAL COSTS ==========>
THE MAXIMUM PROJECT COST IS =======> $ ~~~~~~~~ ~~~~~~~~

DIVISION APPROVED:

DIVISION APPROVED DATE: ____/____/____

K Callan CHIEF, COST ENGINEERING, Kim Callan
R Carlton CHIEF, REAL ESTATE, Richard Carlton
D Cannon CHIEF, PLANNING, Dennis Cannon
S Bham CHIEF, ENGINEERING, Surya Bhamidipaty
James E Blukington CHIEF, OPERATIONS, Wayne John
J Treadwell CHIEF, CONSTRUCTION, John Treadwell
Jackie Anderson CHIEF, CONTRACTING, Jackie Anderson
Kevin E Crum PROJECT MANAGER, Kevin Crum
George R Veighey CHIEF, PM-PB, George Veighey
ent (par) 9/23/99 CHIEF, PPPMD, James Waddell

________ CHIEF, COST ENGINEERING, Wally Brassfield
________ DIRECTOR, REAL ESTATE, Cynthia Brown
________ DIRECTOR OF PROGRAM MANAGEMENT, Mike White
________ DIRECTOR OF ENGINEERING & TECHNICAL SERVICES, Jim Crews
________ CHIEF, CIVIL PROGRAMS, Clyde Barnhill

NOTE: Valid only when completely signed.

Walla Walla District

**** TOTAL PROJECT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: LOWER MONUMENTAL LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99				AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99			.........FULLY FUNDED ESTIMATE.........			
		COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	SPENT THRU FY 97 ($K)	COST ($K)	CNTG ($K)	FULL ($K)
04.1--	DAM - ALT 3 - SOUTH POWER HOUSE GOVERNMENT FURNISH SERVICES	4,464	1,339	30%	5,803	4,464	1,339	5,803		4,821	1,446	6,267
	TOTAL CONSTRUCTION COSTS =====:	4,464	1,339	30%	5,803	4,464	1,339	5,803		4,821	1,446	6,267
01---	LANDS AND DAMAGES											
18---	CULTURAL RESOURCES											
21---	RECONNAISSANCE STUDIES											
22---	FEASIBILITY STUDIES											
30---	PLANNING, ENGINEERING & DESIGN	1,102	330	30%	1,432	1,102	330	1,432		1,157	348	1,505
31---	CONSTRUCTION MANAGEMENT	647	194	30%	841	647	194	841		699	210	909
	TOTAL PROJECT COSTS ==========>	6,213	1,863	30%	8,076	6,213	1,863	8,076		6,677	2,004	8,681

THIS TPCS REFLECTS A PROJECT COST CHANGE OF $ ~~~ ~~~~~ ~~~~~~~~

DISTRICT APPROVED:
DISTRICT APPROVED DATE: 9 / 23 / 99

TOTAL FEDERAL COSTS ==============> 8,681
TOTAL NON-FEDERAL COSTS ==========>
THE MAXIMUM PROJECT COST IS =======> $ ~~~~~~~~ ~~~~~~~~

DIVISION APPROVED:

DIVISION APPROVED DATE: ____/____/____

[signature] CHIEF, COST ENGINEERING, Kim Callan
[signature] CHIEF, REAL ESTATE, Richard Carlton
[signature] CHIEF, PLANNING, Dennis Cannon
[signature] CHIEF, ENGINEERING, Surya Bhamidipaty
[signature] for CHIEF, OPERATIONS, Wayne John
[signature] CHIEF, CONSTRUCTION, John Treadwell
[signature] CHIEF, CONTRACTING, Jackie Anderson
[signature] PROJECT MANAGER, Kevin Crum
[signature] CHIEF, PM-PB, George Veighey
out (pau) 9/23/99 CHIEF, PPPMD, James Waddell

__________ CHIEF, COST ENGINEERING, Wally Brassfield
__________ DIRECTOR, REAL ESTATE, Cynthia Brown
__________ DIRECTOR OF PROGRAM MANAGEMENT, Mike White
__________ DIRECTOR OF ENGINEERING & TECHNICAL SERVICES, Jim Crews
__________ CHIEF, CIVIL PROGRAMS, Clyde Barnhill

NOTE: Valid only when completely signed.

Walla Walla District

APPENDIX D

Construction Cost Estimates - Ice Harbor North Shore Fishway

EMERGENCY AUX WATER SUPPLY
Snake River & Washington
*** Price Level 1 Oct. 1999 ***

Designed By: Walla Walla District COE
Estimated By: Karl Pankaskie/Garth Clausen

Prepared By: Walla Walla, Cost Engineering Br
Kim Callan, Branch Chief

Preparation Date: 09/17/99
Effective Date of Pricing: 09/17/99
Est Construction Time: 200 Days

Sales Tax: 7.90%

LABOR ID: EWWW99 EQUIP ID: NAT97C

Currency in DOLLARS

CREW ID: NAT97A UPB ID: NAT97D

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY

LOCATION: ICE HARBOR LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla

P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

		CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99				AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99				.........FULLY FUNDED ESTIMATE.........				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
	ICE HARBOR DAM - ALT 1 - North Shore REHAB PUMP SYSTEM													
04.01.99	AUXILIARY WATER SUPPLY SYSTEM TECHNICAL REPORT DATED # AUGUST 1999	2,738	685	25%	3,423		2,738	685	3,423	1 QTR 02	8.0%	2,957	740	3,697
	TOTAL CONSTRUCTION COSTS ===>	2,738	685	25%	3,423		2,738	685	3,423			2,957	740	3,697
01---	LANDS AND DAMAGES													
22---	FEASIBILITY STUDIES													
30---	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	71	17	25%	88		71	17	88	3 QTR 00	4.6%	74	18	92
1.0%	Planning & Environmental Compliance	29	7	25%	36		29	7	36	3 QTR 00	4.6%	30	7	37
15.0%	Engineering & Design	424	106	25%	530		424	106	530	3 QTR 00	4.6%	444	111	555
1.0%	Engineering Tech Review & VE	29	7	25%	36		29	7	36	3 QTR 00	4.6%	30	7	37
1.0%	Contracting & Reprographics	29	7	25%	36		29	7	36	3 QTR 00	4.6%	30	7	37
3.0%	Engineering During Construction	82	20	25%	102		82	20	102	1 QTR 02	8.0%	89	22	111
0.5%	Project Operation:	13	4	25%	17		13	4	17	3 QTR 00	4.6%	14	4	18
31---	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	274	69	25%	343		274	69	343	1 QTR 02	8.0%	296	74	370
2.0%	Project Operation:	55	14	25%	69		55	14	69	1 QTR 02	8.0%	59	15	74
2.5%	Project Management	69	17	25%	86		69	17	86	1 QTR 02	8.0%	74	18	92
	TOTAL COSTS ================>	3,813	953	25%	4,766		3,813	953	4,766			4,097	1,023	5,120
	ICE HARBOR DAM - ALT 1 - North Shore													
06.2--	GOVERNMENT FURNISH MATERIALS													
30---	PLANNING, ENGINEERING & DESIGN													
15.0%	Engineering & Design													
1.0%	Contracting & Reprographics													
	TOTAL GFS COSTS =====>													
	MISC COSTS FOR ALL PROJECTS													
18---	CULTURAL RESOURCES													
30---	ANOTHER MISC E & D COSTS													

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
AA ALT #1 REHAB. PUMPS NS									
AA.04 DAMS - NORTH SHORE - ICE HARBOR									
AA.04.01 MAIN DAM									
AA.04.01.99 ASSOCIATED GENERAL ITEMS									
AA.04.01.99|000- DEWATER LADDER AREA		91,441	10,973	9,217	11,163	6,140	1,463	130,397	
AA.04.01.99|001- ELEC REDUNANCY/UPGRADE FOR PUMPS	3.00 EA	299,007	35,881	30,140	36,503	20,077	4,784	426,391	142130.30
AA.04.01.99|002- BULKHEAD CHANGE	2.00 EA	134,515	16,142	13,559	16,422	9,032	2,152	191,821	95910.71
AA.04.01.99|003- MODIFY DIFFUSER OPENING	5.00 EA	122,656	14,719	12,364	14,974	8,236	2,229	175,178	35035.51
AA.04.01.99|004- CRANE TO HANDLE PUMPS/BULKHEADS	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	18,610	1,658,750	1658750
AA.04.01.99|005- FISHWAY ENTRANCE HOIST	1.00 EA	109,557	13,147	11,043	13,375	7,356	1,753	156,231	156230.77
TOTAL ASSOCIATED GENERAL ITEMS	3.00 EA	1,920,376	230,445	193,574	234,439	128,942	30,991	2,738,767	912922.29
TOTAL MAIN DAM		1,920,376	230,445	193,574	234,439	128,942	30,991	2,738,767	
TOTAL DAMS - NORTH SHORE - ICE HARBOR	1.00 EA	1,920,376	230,445	193,574	234,439	128,942	30,991	2,738,767	2738767
TOTAL ALT #1 REHAB. PUMPS NS		1,920,376	230,445	193,574	234,439	128,942	30,991	2,738,767	

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
AA ALT #1 REHAB. PUMPS NS									
AA.04 DAMS - NORTH SHORE - ICE HARBOR									
AA.04.01 MAIN DAM									
AA.04.01.99 ASSOCIATED GENERAL ITEMS									
AA.04.01.99|000- DEWATER LADDER AREA									
AA.04.01.99|000--01AA Dewater Area		9,664	1,160	974	1,180	649	155	13,781	
AA.04.01.99|000--01MA Pump Water out	60.00 DAY	72,122	8,655	7,270	8,805	4,843	1,154	102,848	1714.13
AA.04.01.99|000--01ZZ Water Up Area		9,655	1,159	973	1,179	648	154	13,768	
TOTAL DEWATER LADDER AREA		91,441	10,973	9,217	11,163	6,140	1,463	130,397	
AA.04.01.99|001- ELEC REDUNANCY/UPGRADE FOR PUMPS									
AA.04.01.99|001--16A- Disconnect Electrical on Pumps	3.00 EA	4,878	585	492	596	328	78	6,957	2318.91
AA.04.01.99|001--16AA Motor Starters & Assoc.(250 cfs)	3.00 EA	132,617	15,914	13,368	16,190	8,904	2,122	189,115	63038.45
AA.04.01.99|001--16BB Existing Switchgear Mod.	5.00 EA	57,654	6,919	5,812	7,038	3,871	922	82,216	16443.27
AA.04.01.99|001--16CC Outside Switchgear	3.00 EA	86,415	10,370	8,711	10,550	5,802	1,383	123,229	41076.48
AA.04.01.99|001--16DD Misc Electrical Work	1.00 EA	17,442	2,093	1,758	2,129	1,171	279	24,873	24873.00
TOTAL ELEC REDUNANCY/UPGRADE FOR PUMPS	3.00 EA	299,007	35,881	30,140	36,503	20,077	4,784	426,391	142130.30
AA.04.01.99|002- BULKHEAD CHANGE									
AA.04.01.99|002--02AA Install New Bulkhead(Slide Gate)	2.00 EA	134,515	16,142	13,559	16,422	9,032	2,152	191,821	95910.71
TOTAL BULKHEAD CHANGE	2.00 EA	134,515	16,142	13,559	16,422	9,032	2,152	191,821	95910.71
AA.04.01.99|003- MODIFY DIFFUSER OPENING									
AA.04.01.99|003--02AA Diamond Saw Cut Holes, Openings	5.00 EA	87,439	10,493	8,814	10,675	5,871	1,589	124,881	24976.18
AA.04.01.99|003--03AA Concrete Rebar Dowels	60.00 EA	13,646	1,638	1,376	1,666	916	248	19,489	324.82
AA.04.01.99|003--03CA Patch Concrete Openning	220.00 CF	21,571	2,588	2,174	2,633	1,448	392	30,807	140.03
TOTAL MODIFY DIFFUSER OPENING	5.00 EA	122,656	14,719	12,364	14,974	8,236	2,229	175,178	35035.51
AA.04.01.99|004- CRANE TO HANDLE PUMPS/BULKHEADS									
AA.04.01.99|004--15AA Whirly Crane, 30 Ton	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	18,610	1,658,750	1658750
TOTAL CRANE TO HANDLE PUMPS/BULKHEADS	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	18,610	1,658,750	1658750

	QUANTITY	UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
AA.04.01.99|005- FISHWAY ENTRANCE HOIST										
AA.04.01.99|005--15AA Fishway Entrance Hoist, 10 Ton	1.00	EA	109,557	13,147	11,043	13,375	7,356	1,753	156,231	156230.77
TOTAL FISHWAY ENTRANCE HOIST	1.00	EA	109,557	13,147	11,043	13,375	7,356	1,753	156,231	156230.77
TOTAL ASSOCIATED GENERAL ITEMS	3.00	EA	1,920,376	230,445	193,574	234,439	128,942	30,991	2,738,767	912922.29
TOTAL MAIN DAM			1,920,376	230,445	193,574	234,439	128,942	30,991	2,738,767	
TOTAL DAMS - NORTH SHORE - ICE HARBOR	1.00	EA	1,920,376	230,445	193,574	234,439	128,942	30,991	2,738,767	2738767
TOTAL ALT #1 REHAB. PUMPS NS			1,920,376	230,445	193,574	234,439	128,942	30,991	2,738,767	

EMERGENCY AUX WATER SUPPLY
Snake River & Washington
*** Price Level 1 Oct. 1999 ***

Designed By: Walla Walla District COE
Estimated By: Karl Pankaskie/Garth Clausen

Prepared By: Walla Walla, Cost Engineering Br
Kim Callan, Branch Chief

Preparation Date: 09/17/99
Effective Date of Pricing: 09/17/99
Est Construction Time: 200 Days

Sales Tax: 7.90%

M C A C E S G O L D E D I T I O N

Release 5.30

LABOR ID: EWWW99 EQUIP ID: NAT97C

Currency in DOLLARS

CREW ID: NAT97A UPB ID: NAT97D

**** TOTAL CONTRACT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: ICE HARBOR LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

		CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99				AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99				........FULLY FUNDED ESTIMATE.........				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
	ICE HARBOR DAM - ALT 2 - North Shore UPGRADE PUMP SYSTEM													
04.01.99	AUXILIARY WATER SUPPLY SYSTEM TECHNICAL REPORT DATED # AUGUST 1999	3,838	960	25%	4,798		3,838	960	4,798	1 QTR 02	8.0%	4,145	1,037	5,182
	TOTAL CONSTRUCTION COSTS ===>	3,838	960	25%	4,798		3,838	960	4,798			4,145	1,037	5,182
01---	LANDS AND DAMAGES													
22---	FEASIBILITY STUDIES													
30---	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	99	25	25%	124		99	25	124	3 QTR 00	4.6%	104	26	130
1.0%	Planning & Environmental Compliance	40	10	25%	50		40	10	50	3 QTR 00	4.6%	42	10	52
15.0%	Engineering & Design	594	148	25%	742		594	148	742	3 QTR 00	4.6%	622	155	777
1.0%	Engineering Tech Review & VE	40	10	25%	50		40	10	50	3 QTR 00	4.6%	42	10	52
1.0%	Contracting & Reprographics	40	10	25%	50		40	10	50	3 QTR 00	4.6%	42	10	52
3.0%	Engineering During Construction	115	29	25%	144		115	29	144	1 QTR 02	8.0%	124	31	155
0.5%	Project Operation:	20	5	25%	25		20	5	25	3 QTR 00	4.6%	21	5	26
31---	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	383	96	25%	479		383	96	479	1 QTR 02	8.0%	414	104	518
2.0%	Project Operation:	77	19	25%	96		77	19	96	1 QTR 02	8.0%	83	21	104
2.5%	Project Management	96	24	25%	120		96	24	120	1 QTR 02	8.0%	104	26	130
	TOTAL COSTS ================>	5,342	1,336	25%	6,678		5,342	1,336	6,678			5,743	1,435	7,178
	ICE HARBOR DAM - ALT 2 - North Shore													
06.2--	GOVERNMENT FURNISH MATERIALS													
30---	PLANNING, ENGINEERING & DESIGN													
15.0%	Engineering & Design													
1.0%	Contracting & Reprographics													
	TOTAL GFS COSTS =====>													

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
BB ALT #2 UPGRADE PUMPS NS									
BB.04 DAMS - NORTH SHORE - ICE HARBOR									
BB.04.01 MAIN DAM									
BB.04.01.99 ASSOCIATED GENERAL ITEMS									
BB.04.01.99|000- DEWATER LADDER AREA		91,441	10,973	9,217	11,163	6,140	904	129,837	
BB.04.01.99|001- UPGRADE PUMPS FOR RELIABILITY	3.00 EA	588,368	70,604	59,308	71,828	39,505	5,814	835,428	278475.90
BB.04.01.99|002- ELEC REDUNANCY/UPGRADE FOR PUMPS	3.00 EA	493,506	59,221	49,745	60,247	33,136	4,877	700,733	233577.53
BB.04.01.99|003- BULKHEAD CHANGE	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,329	190,999	95499.33
BB.04.01.99|004- MODIFY DIFFUSER OPENING	5.00 EA	122,656	14,719	12,364	14,974	8,236	1,212	174,160	34832.03
BB.04.01.99|005- CRANE TO HANDLE PUMPS/BULKHEADS	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	11,495	1,651,635	1651635
BB.04.01.99|006- FISHWAY ENTRANCE HOIST	1.00 EA	109,557	13,147	11,043	13,375	7,356	1,083	155,561	155560.66
TOTAL ASSOCIATED GENERAL ITEMS	3.00 EA	2,703,243	324,389	272,487	330,012	181,507	26,714	3,838,352	1279451
TOTAL MAIN DAM		2,703,243	324,389	272,487	330,012	181,507	26,714	3,838,352	
TOTAL DAMS - NORTH SHORE - ICE HARBOR		2,703,243	324,389	272,487	330,012	181,507	26,714	3,838,352	
TOTAL ALT #2 UPGRADE PUMPS NS		2,703,243	324,389	272,487	330,012	181,507	26,714	3,838,352	

		QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
BB	ALT #2 UPGRADE PUMPS NS									
BB.04	DAMS - NORTH SHORE - ICE HARBOR									
BB.04.01	MAIN DAM									
BB.04.01.99	ASSOCIATED GENERAL ITEMS									
BB.04.01.99|000-	DEWATER LADDER AREA									
BB.04.01.99|000--01AA	Dewater Area		9,664	1,160	974	1,180	649	96	13,722	
BB.04.01.99|000--01MA	Pump Water out	60.00 DAY	72,122	8,655	7,270	8,805	4,843	713	102,406	1706.77
BB.04.01.99|000--01ZZ	Water Up Area		9,655	1,159	973	1,179	648	95	13,709	
	TOTAL DEWATER LADDER AREA		91,441	10,973	9,217	11,163	6,140	904	129,837	
BB.04.01.99|001-	UPGRADE PUMPS FOR RELIABILITY									
BB.04.01.99|001--15AA	Upgrade Pumps to 300 cfs	3.00 EA	588,368	70,604	59,308	71,828	39,505	5,814	835,428	278475.90
	TOTAL UPGRADE PUMPS FOR RELIABILITY	3.00 EA	588,368	70,604	59,308	71,828	39,505	5,814	835,428	278475.90
BB.04.01.99|002-	ELEC REDUNANCY/UPGRADE FOR PUMPS									
BB.04.01.99|002--16AA	Motor Starters and Assoc.	3.00 EA	176,021	21,123	17,743	21,489	11,819	1,739	249,933	83311.10
BB.04.01.99|002--16BB	Existing Switchgear Mod.	5.00 EA	79,562	9,547	8,020	9,713	5,342	786	112,970	22593.98
BB.04.01.99|002--16CC	Outside Switchgear	3.00 EA	90,796	10,896	9,152	11,084	6,096	897	128,922	42974.04
BB.04.01.99|002--16DD	Misc Electrical Work	1.00 EA	18,435	2,212	1,858	2,251	1,238	182	26,176	26175.59
BB.04.01.99|002--16EE	New Pump Motors, 300 HP, 4160V	3.00 EA	128,693	15,443	12,972	15,711	8,641	1,272	182,732	60910.56
	TOTAL ELEC REDUNANCY/UPGRADE FOR PUMPS	3.00 EA	493,506	59,221	49,745	60,247	33,136	4,877	700,733	233577.53
BB.04.01.99|003-	BULKHEAD CHANGE									
BB.04.01.99|003--02AA	Install New Bulkhead(Slide Gate)	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,329	190,999	95499.33
	TOTAL BULKHEAD CHANGE	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,329	190,999	95499.33
BB.04.01.99|004-	MODIFY DIFFUSER OPENING									
BB.04.01.99|004--02AA	Diamond Saw Cut Holes, Openings	5.00 EA	87,439	10,493	8,814	10,675	5,871	864	124,156	24831.13
BB.04.01.99|004--03AA	Concrete Rebar Dowels	60.00 EA	13,646	1,638	1,376	1,666	916	135	19,376	322.94
BB.04.01.99|004--03CA	Patch Concrete Openning	220.00 CF	21,571	2,588	2,174	2,633	1,448	213	30,628	139.22
	TOTAL MODIFY DIFFUSER OPENING	5.00 EA	122,656	14,719	12,364	14,974	8,236	1,212	174,160	34832.03

	QUANTITY	UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
BB.04.01.99|005- CRANE TO HANDLE PUMPS/BULKHEADS										
BB.04.01.99|005--15AA Whirly Crane, 30 Ton	1.00	EA	1,163,200	139,584	117,251	142,003	78,102	11,495	1,651,635	1651635
TOTAL CRANE TO HANDLE PUMPS/BULKHEADS	1.00	EA	1,163,200	139,584	117,251	142,003	78,102	11,495	1,651,635	1651635
BB.04.01.99|006- FISHWAY ENTRANCE HOIST										
BB.04.01.99|006--15AA Fishway Entrance Hoist, 10 Ton	1.00	EA	109,557	13,147	11,043	13,375	7,356	1,083	155,561	155560.66
TOTAL FISHWAY ENTRANCE HOIST	1.00	EA	109,557	13,147	11,043	13,375	7,356	1,083	155,561	155560.66
TOTAL ASSOCIATED GENERAL ITEMS	3.00	EA	2,703,243	324,389	272,487	330,012	181,507	26,714	3,838,352	1279451
TOTAL MAIN DAM			2,703,243	324,389	272,487	330,012	181,507	26,714	3,838,352	
TOTAL DAMS - NORTH SHORE - ICE HARBOR			2,703,243	324,389	272,487	330,012	181,507	26,714	3,838,352	
TOTAL ALT #2 UPGRADE PUMPS NS			2,703,243	324,389	272,487	330,012	181,507	26,714	3,838,352	

EMERGENCY AUX WATER SUPPLY
Snake River & Washington
*** Price Level 1 Oct. 1999 ***

Designed By: Walla Walla District COE
Estimated By: Karl Pankaskie/Garth Clausen

Prepared By: Walla Walla, Cost Engineering Br
Kim Callan, Branch Chief

Preparation Date: 09/17/99
Effective Date of Pricing: 09/17/99
Est Construction Time: 200 Days

Sales Tax: 7.90%

LABOR ID: EWWW99   EQUIP ID: NAT97C   Currency in DOLLARS   CREW ID: NAT97A   UPB ID: NAT97D

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: ICE HARBOR LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

		CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99				AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99				.........FULLY FUNDED ESTIMATE.........				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
04.01.99	ICE HARBOR DAM - ALT 3 a - North Shore GRAVITY PUMP SYSTEM AUXILIARY WATER SUPPLY SYSTEM TECHNICAL REPORT DATED # AUGUST 1999	6,094	1,219	20%	7,313		6,094	1,219	7,313	1 QTR 02	8.0%	6,582	1,317	7,899
	TOTAL CONSTRUCTION COSTS ===>	6,094	1,219	20%	7,313		6,094	1,219	7,313			6,582	1,317	7,899
01---	LANDS AND DAMAGES													
22---	FEASIBILITY STUDIES													
30---	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	157	32	20%	189		157	32	189	3 QTR 00	4.6%	164	33	197
1.0%	Planning & Environmental Compliance	63	12	20%	75		63	12	75	3 QTR 00	4.6%	66	13	79
15.0%	Engineering & Design	944	188	20%	1,132		944	188	1,132	3 QTR 00	4.6%	988	197	1,185
1.0%	Engineering Tech Review & VE	63	12	20%	75		63	12	75	3 QTR 00	4.6%	66	13	79
1.0%	Contracting & Reprographics	63	12	20%	75		63	12	75	3 QTR 00	4.6%	66	13	79
3.0%	Engineering During Construction	183	36	20%	219		183	36	219	1 QTR 02	8.0%	198	39	237
0.5%	Project Operation:	32	6	20%	38		32	6	38	3 QTR 00	4.6%	33	6	39
31---	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	609	122	20%	731		609	122	731	1 QTR 02	8.0%	658	132	790
2.0%	Project Operation:	122	24	20%	146		122	24	146	1 QTR 02	8.0%	132	26	158
2.5%	Project Management	152	31	20%	183		152	31	183	1 QTR 02	8.0%	164	33	197
	TOTAL COSTS ================>	8,482	1,694	20%	10,176		8,482	1,694	10,176			9,117	1,822	10,939
06.2--	ICE HARBOR DAM - ALT 3 a - North Shore GOVERNMENT FURNISH MATERIALS													
30---	PLANNING, ENGINEERING & DESIGN													
15.0%	Engineering & Design													
1.0%	Contracting & Reprographics													
	TOTAL GFS COSTS =====>													

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
CC ALT #3aGRAVITY FEED SYSTEM NS									
CC.04 DAMS - NORTH SHORE - ICE HARBOR									
CC.04.01 MAIN DAM									
CC.04.01.99 ASSOCIATED GENERAL ITEMS									
CC.04.01.99|000- DEWATER LADDER AREA		91,441	10,973	9,217	11,163	6,140	825	129,759	
CC.04.01.99|001A INTAKE STRUCTURE(T-SCREENS TYPE)		905,273	108,633	91,252	110,516	60,784	8,172	1,284,629	
CC.04.01.99|002A WATER TRANSPORT STR (CONE TYPE)	140.00 LF	1,274,781	152,974	128,498	155,625	85,594	11,508	1,808,979	12921.28
CC.04.01.99|002X ACCESS CRANE (FOR CONE VALVE)	1.00 EA	200,000	24,000	20,160	24,416	13,429	1,805	283,810	283810.27
CC.04.01.99|003- ELECTRICAL UPGRADE FOR PUMPS		293,775	35,253	29,613	35,864	19,725	2,652	416,882	
CC.04.01.99|004- BULKHEAD CHANGE	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,214	190,884	95441.83
CC.04.01.99|005- MODIFY DIFFUSER OPENING	5.00 EA	122,656	14,719	12,364	14,974	8,236	2,229	175,178	35035.51
CC.04.01.99|006- CRANE TO HANDLE PUMPS/BULKHEADS	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	10,501	1,650,641	1650641
CC.04.01.99|007- FISHWAY ENTRANCE HOIST	1.00 EA	109,557	13,147	11,043	13,375	7,356	989	155,467	155467.01
TOTAL ASSOCIATED GENERAL ITEMS		4,295,198	515,424	432,956	524,358	288,397	39,896	6,096,229	
TOTAL MAIN DAM		4,295,198	515,424	432,956	524,358	288,397	39,896	6,096,229	
TOTAL DAMS - NORTH SHORE - ICE HARBOR	1.00 EA	4,295,198	515,424	432,956	524,358	288,397	39,896	6,096,229	6096229
TOTAL ALT #3aGRAVITY FEED SYSTEM NS		4,295,198	515,424	432,956	524,358	288,397	39,896	6,096,229	

		QUANTITY	UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
CC ALT #3aGRAVITY FEED SYSTEM NS											
CC.04 DAMS - NORTH SHORE - ICE HARBOR											
CC.04.01 MAIN DAM											
CC.04.01.99 ASSOCIATED GENERAL ITEMS											
CC.04.01.99|000- DEWATER LADDER AREA											
CC.04.01.99|000--01AA	Dewater Area			9,664	1,160	974	1,180	649	87	13,714	
CC.04.01.99|000--01MA	Pump Water out	60.00	DAY	72,122	8,655	7,270	8,805	4,843	651	102,345	1705.75
CC.04.01.99|000--01ZZ	Water Up Area			9,655	1,159	973	1,179	648	87	13,701	
	TOTAL DEWATER LADDER AREA			91,441	10,973	9,217	11,163	6,140	825	129,759	
CC.04.01.99|001A INTAKE STRUCTURE(T-SCREENS TYPE)											
CC.04.01.99|001A-1000	METAL INTAKE CASSION TT	1.00	EA	0	0	0	0	0	0	0	0.01
CC.04.01.99|001A-102C	Cassion Slide Gate,Drill 2" Hole	1.00	EA	1,200	144	121	146	81	11	1,703	1702.86
CC.04.01.99|001A-102D	Cassion Anchors Bolts Installtn	89.00	EA	44,812	5,377	4,517	5,471	3,009	405	63,590	714.50
CC.04.01.99|001A-105A	Cassion Metal Intake, 1 Each	50000.00	LB	94,673	11,361	9,543	11,558	6,357	855	134,345	2.69
CC.04.01.99|001A-115A	Cassion Slide Gate (Bulkhead)	1.00	EA	49,560	5,947	4,996	6,050	3,328	447	70,329	70328.80
CC.04.01.99|001A-2000	METAL INTAKE PIPE BRANCHS TT	2.00	EA	0	0	0	0	0	0	0	0.01
CC.04.01.99|001A-202D	Branch Anchors Bolts Installatn	32.00	EA	15,679	1,882	1,580	1,914	1,053	142	22,250	695.30
CC.04.01.99|001A-205A	Branch Anchor Ring Installation	8.00	EA	37,967	4,556	3,827	4,635	2,549	343	53,876	6734.55
CC.04.01.99|001A-205D	Branch 60" Dia Piping Installatn	80.00	LF	36,915	4,430	3,721	4,507	2,479	333	52,384	654.80
CC.04.01.99|001A-3000	METAL INTAKE SCREEN ASSEMBLES TT	6.00	EA	0	0	0	0	0	0	0	0.01
CC.04.01.99|001A-305C	Intake SS Tee Screen Assembles	6.00	EA	484,979	58,197	48,886	59,206	32,563	4,378	688,210	114701.59
CC.04.01.99|001A-4000	METAL INTAKE AIR BURST SYSTEM TT	1.00	EA	0	0	0	0	0	0	0	0.01
CC.04.01.99|001A-413C	Air Burst Compressor & 17KL Tank	1.00	EA	41,062	4,927	4,139	5,013	2,757	371	58,270	58269.79
CC.04.01.99|001A-415C	Air Burst Piping, 10" Lines	200.00	LF	44,430	5,332	4,479	5,424	2,983	401	63,049	315.24
CC.04.01.99|001A-415D	Air Burst Piping, 1/2" Lines	500.00	LF	26,321	3,159	2,653	3,213	1,767	238	37,351	74.70
CC.04.01.99|001A-416A	Air Burst System, Electrical			27,675	3,321	2,790	3,379	1,858	250	39,272	
	TOTAL INTAKE STRUCTURE(T-SCREENS TYPE)			905,273	108,633	91,252	110,516	60,784	8,172	1,284,629	
CC.04.01.99|002A WATER TRANSPORT STR (CONE TYPE)											
CC.04.01.99|002A-1000	WATER LINE & END VALVE TT	1.00	EA	0	0	0	0	0	0	0	0.01
CC.04.01.99|002A-102A	Drill 84" Dia Hole into Dam	38.00	LF	114,000	13,680	11,491	13,917	7,654	1,029	161,772	4257.15
CC.04.01.99|002A-103A	Grout Pipe in Hole into Dam	15.00	CY	4,463	536	450	545	300	40	6,333	422.18
CC.04.01.99|002A-105A	Anchor Block For Pipe Dam	1.00	LB	7,193	863	725	878	483	65	10,208	10207.88
CC.04.01.99|002A-105C	Access Stairs and Platform	150.00	SF	35,955	4,315	3,624	4,389	2,414	325	51,022	340.14
CC.04.01.99|002A-115A	72" Dia Steel Epoxy Pipe Line	140.00	LF	111,678	13,401	11,257	13,634	7,498	1,008	158,476	1131.97
CC.04.01.99|002A-115C	12" Dia Air Release Valve	1.00	EA	4,555	547	459	556	306	41	6,464	6464.25
CC.04.01.99|002A-115D	52" Dia Cone Valve	1.00	EA	122,157	14,659	12,313	14,913	8,202	1,103	173,347	173347.20
CC.04.01.99|002A-16AA	52" Cone Valve, Electrical			23,897	2,868	2,409	2,917	1,605	216	33,912	

		QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
CC.04.01.99|002A-5000	PRESSTRESS TENDONS IN WALL TT	104.00 EA	1	0	0	0	0	0	1	0.01
CC.04.01.99|002A-502A	Tendons, Drilling 4" Dia Holes	7905.00 LF	347,425	41,691	35,020	42,414	23,328	3,136	493,014	62.37
CC.04.01.99|002A-505A	Tendons, Settng,Placing&Mat Cost	104.00 EA	203,836	24,460	20,547	24,884	13,686	1,840	289,254	2781.29
CC.04.01.99|002A-505B	Tendons, Initial Cleanng	104.00 EA	11,410	1,369	1,150	1,393	766	103	16,191	155.69
CC.04.01.99|002A-505E	Tendons, Initial Stressing	104.00 EA	30,593	3,671	3,084	3,735	2,054	276	43,413	417.43
CC.04.01.99|002A-505F	Tendons, Initial Grouting	104.00 EA	8,217	986	828	1,003	552	74	11,660	112.12
CC.04.01.99|002A-505G	Tendons, Final Stressing	104.00 EA	35,728	4,287	3,601	4,362	2,399	323	50,699	487.49
CC.04.01.99|002A-505H	Tendons, Final Grout	104.00 EA	18,173	2,181	1,832	2,219	1,220	164	25,788	247.96
CC.04.01.99|002A-6000	METAL FLOW WING GATES TT	2.00 EA	0	0	0	0	0	0	0	0.01
CC.04.01.99|002A-601B	Dewater Inside Bay Area		5,559	667	560	679	373	50	7,888	
CC.04.01.99|002A-602B	Wing Gate,Openning In Ex Concr	2.00 EA	44,168	5,300	4,452	5,392	2,966	399	62,676	31338.22
CC.04.01.99|002A-602D	Wing Gate,Operater Hole in Conc	4.00 EA	640	77	65	78	43	6	908	227.05
CC.04.01.99|002A-603B	Conc.Plug Openning Training Wall	7.00 EA	32,857	3,943	3,312	4,011	2,206	297	46,625	6660.78
CC.04.01.99|002A-603D	Wing Gate,Grout Support Guides	4.00 EA	990	119	100	121	66	9	1,405	351.33
CC.04.01.99|002A-605B	Wing Gate,Handrail	48.00 LF	1,128	135	114	138	76	10	1,601	33.35
CC.04.01.99|002A-605D	Wing Gate,Access Stairway	140.00 SF	25,681	3,082	2,589	3,135	1,724	232	36,442	260.30
CC.04.01.99|002A-615A	Wing Gate,Metal Gates & Guides	2.00 EA	77,688	9,323	7,831	9,484	5,216	701	110,243	55121.63
CC.04.01.99|002A-615B	Wing Gate,Pnumatic Cylinder	1.00 EA	2,198	264	222	268	148	20	3,120	3119.63
CC.04.01.99|002A-615D	Wing Gate,Compress Air Line	500.00 LF	4,590	551	463	560	308	41	6,514	13.03
	TOTAL WATER TRANSPORT STR (CONE TYPE)	140.00 LF	1,274,781	152,974	128,498	155,625	85,594	11,508	1,808,979	12921.28
CC.04.01.99|002X	ACCESS CRANE (FOR CONE VALVE)	1.00 EA	200,000	24,000	20,160	24,416	13,429	1,805	283,810	283810.27
CC.04.01.99|003-	ELECTRICAL UPGRADE FOR PUMPS									
CC.04.01.99|003--0001	Motor Starters & Assoc.(250 cfs)	3.00 EA	132,617	15,914	13,368	16,190	8,904	1,197	188,191	62730.28
CC.04.01.99|003--0002	Existing Switchgear Mod.	1.00 EA	57,654	6,919	5,812	7,038	3,871	520	81,814	81814.41
CC.04.01.99|003--0003	Outside Switchgear	1.00 EA	86,415	10,370	8,711	10,550	5,802	780	122,627	122627.01
CC.04.01.99|003--0004	Misc Work	1.00 EA	17,089	2,051	1,723	2,086	1,147	154	24,250	24249.83
	TOTAL ELECTRICAL UPGRADE FOR PUMPS		293,775	35,253	29,613	35,864	19,725	2,652	416,882	
CC.04.01.99|004-	BULKHEAD CHANGE									
CC.04.01.99|004--02AA	Install New Bulkhead(Slide Gate)	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,214	190,884	95441.83
	TOTAL BULKHEAD CHANGE	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,214	190,884	95441.83
CC.04.01.99|005-	MODIFY DIFFUSER OPENING									
CC.04.01.99|005--02AA	Diamond Saw Cut Holes, Openings	5.00 EA	87,439	10,493	8,814	10,675	5,871	1,589	124,881	24976.18
CC.04.01.99|005--03AA	Concrete Rebar Dowels	60.00 EA	13,646	1,638	1,376	1,666	916	248	19,489	324.82
CC.04.01.99|005--03CA	Patch Concrete Openning	220.00 CF	21,571	2,588	2,174	2,633	1,448	392	30,807	140.03
	TOTAL MODIFY DIFFUSER OPENING	5.00 EA	122,656	14,719	12,364	14,974	8,236	2,229	175,178	35035.51
CC.04.01.99|006-	CRANE TO HANDLE PUMPS/BULKHEADS									

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
CC.04.01.99|006--15AA Whirly Crane, 30 Ton	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	10,501	1,650,641	1650641
TOTAL CRANE TO HANDLE PUMPS/BULKHEADS	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	10,501	1,650,641	1650641
CC.04.01.99|007- FISHWAY ENTRANCE HOIST									
CC.04.01.99|007--15AA Fishway Entrance Hoist, 10 Ton	1.00 EA	109,557	13,147	11,043	13,375	7,356	989	155,467	155467.01
TOTAL FISHWAY ENTRANCE HOIST	1.00 EA	109,557	13,147	11,043	13,375	7,356	989	155,467	155467.01
TOTAL ASSOCIATED GENERAL ITEMS		4,295,198	515,424	432,956	524,358	288,397	39,896	6,096,229	
TOTAL MAIN DAM		4,295,198	515,424	432,956	524,358	288,397	39,896	6,096,229	
TOTAL DAMS - NORTH SHORE - ICE HARBOR	1.00 EA	4,295,198	515,424	432,956	524,358	288,397	39,896	6,096,229	6096229
TOTAL ALT #3aGRAVITY FEED SYSTEM NS		4,295,198	515,424	432,956	524,358	288,397	39,896	6,096,229	

EMERGENCY AUX WATER SUPPLY
Snake River & Washington
*** Price Level 1 Oct. 1999 ***

Designed By:	Walla Walla District COE
Estimated By:	Karl Pankaskie/Garth Clausen
Prepared By:	Walla Walla, Cost Engineering Br Kim Callan, Branch Chief
Preparation Date:	09/17/99
Effective Date of Pricing:	09/17/99
Est Construction Time:	200 Days
Sales Tax:	7.90%

Currency in DOLLARS

LABOR ID: EWWW99 EQUIP ID: NAT97C CREW ID: NAT97A UPB ID: NAT97D

CODE BFL?? CONTRACT ? **** TOTAL CONTRACT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: ICE HARBOR LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99, EFFECTIVE PRICING LEVEL: 1 OCT 99 — COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: 2000, EFFECT. PRICING LEVEL: 1 OCT 99 — OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	……FULLY FUNDED ESTIMATE…… FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
04.01.99	ICE HARBOR DAM - ALT 3 b - North Shore GRAVITY PUMP SYSTEM AUXILIARY WATER SUPPLY SYSTEM TECHNICAL REPORT DATED # AUGUST 1999	6,174	1,235	20%	7,409		6,174	1,235	7,409	1 QTR 02	8.0%	6,668	1,334	8,002
	TOTAL CONSTRUCTION COSTS ===>	6,174	1,235	20%	7,409		6,174	1,235	7,409			6,668	1,334	8,002
01---	LANDS AND DAMAGES													
22---	FEASIBILITY STUDIES													
30---	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	160	32	20%	192		160	32	192	3 QTR 00	4.6%	167	33	200
1.0%	Planning & Environmental Compliance	64	12	20%	76		64	12	76	3 QTR 00	4.6%	67	13	80
15.0%	Engineering & Design	956	191	20%	1,147		956	191	1,147	3 QTR 00	4.6%	1,000	200	1,200
1.0%	Engineering Tech Review & VE	64	12	20%	76		64	12	76	3 QTR 00	4.6%	67	13	80
1.0%	Contracting & Reprographics	64	12	20%	76		64	12	76	3 QTR 00	4.6%	67	13	80
3.0%	Engineering During Construction	185	37	20%	222		185	37	222	1 QTR 02	8.0%	200	40	240
0.5%	Project Operation:	32	7	20%	39		32	7	39	3 QTR 00	4.6%	33	7	40
31---	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	618	123	20%	741		618	123	741	1 QTR 02	8.0%	667	133	800
2.0%	Project Operation:	123	25	20%	148		123	25	148	1 QTR 02	8.0%	133	27	160
2.5%	Project Management	155	31	20%	186		155	31	186	1 QTR 02	8.0%	167	33	200
	TOTAL COSTS ===============>	8,595	1,717	20%	10,312		8,595	1,717	10,312			9,236	1,846	11,082
06.2--	ICE HARBOR DAM - ALT 3 b - North Shore GOVERNMENT FURNISH MATERIALS													
30---	PLANNING, ENGINEERING & DESIGN													
15.0%	Engineering & Design													
1.0%	Contracting & Reprographics													
	TOTAL GFS COSTS =====>													
18---	MISC COSTS FOR ALL PROJECTS CULTURAL RESOURCES													
30---	ANOTHER MISC E & D COSTS													

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
CN ALT #3bGRAVITY FEED SYSTEM NS									
CN.04 DAMS - NORTH SHORE - ICE HARBOR									
CN.04.01 MAIN DAM									
CN.04.01.99 ASSOCIATED GENERAL ITEMS									
CN.04.01.99|000- DEWATER LADDER AREA		91,441	10,973	9,217	11,163	6,140	848	129,781	
CN.04.01.99|001A INTAKE STRUCTURE(T-SCREENS TYPE)		905,273	108,633	91,252	110,516	60,784	9,222	1,285,679	
CN.04.01.99|002B WATER TRANSPORT STR(INLINE SLEEV		1,229,649	147,558	123,949	150,116	82,564	11,538	1,745,372	
CN.04.01.99|002X ACCESS CRANE (FOR INLINE SLEEVE)	1.00 EA	300,000	36,000	30,240	36,624	20,143	2,780	425,788	425787.70
CN.04.01.99|003- ELECTRICAL UPGRADE FOR PUMPS		293,775	35,253	29,613	35,864	19,725	4,056	418,286	
CN.04.01.99|004- BULKHEAD CHANGE	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,247	190,916	95458.04
CN.04.01.99|005- MODIFY DIFFUSER OPENING	5.00 EA	122,656	14,719	12,364	14,974	8,236	2,229	175,178	35035.51
CN.04.01.99|006- CRANE TO HANDLE PUMPS/BULKHEADS	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	10,781	1,650,921	1650921
CN.04.01.99|007- FISHWAY ENTRANCE HOIST	1.00 EA	109,557	13,147	11,043	13,375	7,356	1,015	155,493	155493.41
TOTAL ASSOCIATED GENERAL ITEMS		4,350,066	522,008	438,487	531,056	292,081	43,716	6,177,414	
TOTAL MAIN DAM		4,350,066	522,008	438,487	531,056	292,081	43,716	6,177,414	
TOTAL DAMS - NORTH SHORE - ICE HARBOR	1.00 EA	4,350,066	522,008	438,487	531,056	292,081	43,716	6,177,414	6177414
TOTAL ALT #3bGRAVITY FEED SYSTEM NS		4,350,066	522,008	438,487	531,056	292,081	43,716	6,177,414	

		QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
CN	ALT #3bGRAVITY FEED SYSTEM NS									
CN.04	DAMS - NORTH SHORE - ICE HARBOR									
CN.04.01	MAIN DAM									
CN.04.01.99	ASSOCIATED GENERAL ITEMS									
CN.04.01.99|000-	DEWATER LADDER AREA									
CN.04.01.99|000--01AA	Dewater Area		9,664	1,160	974	1,180	649	90	13,716	
CN.04.01.99|000--01MA	Pump Water out	60.00 DAY	72,122	8,655	7,270	8,805	4,843	668	102,362	1706.04
CN.04.01.99|000--01ZZ	Water Up Area		9,655	1,159	973	1,179	648	89	13,703	
	TOTAL DEWATER LADDER AREA		91,441	10,973	9,217	11,163	6,140	848	129,781	
CN.04.01.99|001A	INTAKE STRUCTURE(T-SCREENS TYPE)									
CN.04.01.99|001A-1000	METAL INTAKE CASSION TT	1.00 EA	0	0	0	0	0	0	0	0.01
CN.04.01.99|001A-102C	Cassion Slide Gate,Drill 2" Hole	1.00 EA	1,200	144	121	146	81	11	1,703	1703.15
CN.04.01.99|001A-102D	Cassion Anchors Bolts Installtn	89.00 EA	44,812	5,377	4,517	5,471	3,009	593	63,778	716.61
CN.04.01.99|001A-105A	Cassion Metal Intake, 1 Each	50000.00 LB	94,673	11,361	9,543	11,558	6,357	877	134,368	2.69
CN.04.01.99|001A-115A	Cassion Slide Gate (Bulkhead)	1.00 EA	49,560	5,947	4,996	6,050	3,328	459	70,341	70340.74
CN.04.01.99|001A-2000	METAL INTAKE PIPE BRANCHS TT	2.00 EA	0	0	0	0	0	0	0	0.01
CN.04.01.99|001A-202D	Branch Anchors Bolts Installatn	32.00 EA	15,679	1,882	1,580	1,914	1,053	209	22,317	697.40
CN.04.01.99|001A-205A	Branch Anchor Ring Installation	8.00 EA	37,967	4,556	3,827	4,635	2,549	520	54,054	6756.74
CN.04.01.99|001A-205D	Branch 60" Dia Piping Installatn	80.00 LF	36,915	4,430	3,721	4,507	2,479	426	52,477	655.96
CN.04.01.99|001A-3000	METAL INTAKE SCREEN ASSEMBLES TT	6.00 EA	0	0	0	0	0	0	0	0.01
CN.04.01.99|001A-305C	Intake SS Tee Screen Assembles	6.00 EA	484,979	58,197	48,886	59,206	32,563	4,621	688,453	114742.12
CN.04.01.99|001A-4000	METAL INTAKE AIR BURST SYSTEM TT	1.00 EA	0	0	0	0	0	0	0	0.01
CN.04.01.99|001A-413C	Air Burst Compressor & 17KL Tank	1.00 EA	41,062	4,927	4,139	5,013	2,757	381	58,280	58279.68
CN.04.01.99|001A-415C	Air Burst Piping, 10" Lines	200.00 LF	44,430	5,332	4,479	5,424	2,983	412	63,060	315.30
CN.04.01.99|001A-415D	Air Burst Piping, 1/2" Lines	500.00 LF	26,321	3,159	2,653	3,213	1,767	331	37,445	74.89
CN.04.01.99|001A-416A	Air Burst System, Electrical		27,675	3,321	2,790	3,379	1,858	382	39,404	
	TOTAL INTAKE STRUCTURE(T-SCREENS TYPE)		905,273	108,633	91,252	110,516	60,784	9,222	1,285,679	
CN.04.01.99|002B	WATER TRANSPORT STR(INLINE SLEEV									
CN.04.01.99|002B-1000	WATER LINE & END VALVE TT	1.00 EA	0	0	0	0	0	0	0	0.01
CN.04.01.99|002B-102A	Drill 84" Dia Hole into Dam	38.00 LF	114,000	13,680	11,491	13,917	7,654	1,057	161,799	4257.88
CN.04.01.99|002B-102B	Grout Pipe in Hole into Dam	15.00 CY	4,463	536	450	545	300	41	6,334	422.26
CN.04.01.99|002B-102K	Drill 168" Dia Hole into Conduit	1.00 EA	14,645	1,757	1,476	1,788	983	136	20,785	20785.33
CN.04.01.99|002B-105A	Inital Anchor Block,Pipe D-Curve	1.00 EA	7,193	863	725	878	483	67	10,210	10209.62
CN.04.01.99|002B-105B	Pipe Support Piping	9.00 EA	21,643	2,597	2,182	2,642	1,453	201	30,718	3413.07
CN.04.01.99|002B-105C	Inital Anchor Block, Pipe Sleeve	1.00 EA	7,193	863	725	878	483	67	10,210	10209.62
CN.04.01.99|002B-105D	Upper Access Stairs & Platform	150.00 SF	35,955	4,315	3,624	4,389	2,414	333	51,030	340.20
CN.04.01.99|002B-105E	Lower Access Stairs & Platform	651.00 SF	124,592	14,951	12,559	15,210	8,366	1,155	176,832	271.63

		QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
CN.04.01.99|002B-105K	Flow Hood & Down Well	50000.00 LB	98,897	11,868	9,969	12,073	6,640	917	140,364	2.81
CN.04.01.99|002B-115A	72" Dia Steel Epoxy Pipe Line	600.00 LF	414,636	49,756	41,795	50,619	27,840	3,843	588,490	980.82
CN.04.01.99|002B-115C	12" Dia Air Release Valve	1.00 EA	4,555	547	459	556	306	42	6,465	6465.35
CN.04.01.99|002B-115D	60" Dia Inline Sleeve Valve	1.00 EA	350,805	42,097	35,361	42,826	23,554	3,251	497,894	497894.14
CN.04.01.99|002B-16AA	60" Sleeve Valve, Electrical		31,072	3,729	3,132	3,793	2,086	429	44,241	
	TOTAL WATER TRANSPORT STR(INLINE SLEEV		1,229,649	147,558	123,949	150,116	82,564	11,538	1,745,372	
CN.04.01.99|002X	ACCESS CRANE (FOR INLINE SLEEVE)	1.00 EA	300,000	36,000	30,240	36,624	20,143	2,780	425,788	425787.70
CN.04.01.99|003-	ELECTRICAL UPGRADE FOR PUMPS									
CN.04.01.99|003--0001	Motor Starters & Assoc.(250 cfs)	3.00 EA	132,617	15,914	13,368	16,190	8,904	1,831	188,825	62941.51
CN.04.01.99|003--0002	Existing Switchgear Mod.	1.00 EA	57,654	6,919	5,812	7,038	3,871	796	82,090	82089.91
CN.04.01.99|003--0003	Outside Switchgear	1.00 EA	86,415	10,370	8,711	10,550	5,802	1,193	123,040	123039.94
CN.04.01.99|003--0004	Misc Work	1.00 EA	17,089	2,051	1,723	2,086	1,147	236	24,331	24331.49
	TOTAL ELECTRICAL UPGRADE FOR PUMPS		293,775	35,253	29,613	35,864	19,725	4,056	418,286	
CN.04.01.99|004-	BULKHEAD CHANGE									
CN.04.01.99|004--02AA	Install New Bulkhead(Slide Gate)	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,247	190,916	95458.04
	TOTAL BULKHEAD CHANGE	2.00 EA	134,515	16,142	13,559	16,422	9,032	1,247	190,916	95458.04
CN.04.01.99|005-	MODIFY DIFFUSER OPENING									
CN.04.01.99|005--02AA	Diamond Saw Cut Holes, Openings	5.00 EA	87,439	10,493	8,814	10,675	5,871	1,589	124,881	24976.18
CN.04.01.99|005--03AA	Concrete Rebar Dowels	60.00 EA	13,646	1,638	1,376	1,666	916	248	19,489	324.82
CN.04.01.99|005--03CA	Patch Concrete Openning	220.00 CF	21,571	2,588	2,174	2,633	1,448	392	30,807	140.03
	TOTAL MODIFY DIFFUSER OPENING	5.00 EA	122,656	14,719	12,364	14,974	8,236	2,229	175,178	35035.51
CN.04.01.99|006-	CRANE TO HANDLE PUMPS/BULKHEADS									
CN.04.01.99|006--15AA	Whirly Crane, 30 Ton	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	10,781	1,650,921	1650921
	TOTAL CRANE TO HANDLE PUMPS/BULKHEADS	1.00 EA	1,163,200	139,584	117,251	142,003	78,102	10,781	1,650,921	1650921
CN.04.01.99|007-	FISHWAY ENTRANCE HOIST									
CN.04.01.99|007--15AA	Fishway Entrance Hoist, 10 Ton	1.00 EA	109,557	13,147	11,043	13,375	7,356	1,015	155,493	155493.41
	TOTAL FISHWAY ENTRANCE HOIST	1.00 EA	109,557	13,147	11,043	13,375	7,356	1,015	155,493	155493.41
	TOTAL ASSOCIATED GENERAL ITEMS		4,350,066	522,008	438,487	531,056	292,081	43,716	6,177,414	

U.S. Army Corps of Engineers
PROJECT AUXIH7: EMERGENCY AUX WATER SUPPLY - Snake River & Washington
Ice Habor Alt #3b, North Shore Estimate 9/17/99
** PROJECT INDIRECT SUMMARY - CSI ITEM **

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
TOTAL MAIN DAM		4,350,066	522,008	438,487	531,056	292,081	43,716	6,177,414	
TOTAL DAMS - NORTH SHORE - ICE HARBOR	1.00 EA	4,350,066	522,008	438,487	531,056	292,081	43,716	6,177,414	6177414
TOTAL ALT #3bGRAVITY FEED SYSTEM NS		4,350,066	522,008	438,487	531,056	292,081	43,716	6,177,414	

Estimate Preparation for Table 2-6
Filename: table26.xls
Date: 9-17-99
Based on 09/17/99 estimate

INPUTS		Contingency	OUTPUTS	
Item	Cost		Alternative	Cost
Alternative 1	$2,738,768	25	1 (Criteria Revision and System Improvements)	$3,423,460
Dewater Ladder Area	$130,397		Electrical Upgrade and Redundancy	$532,989
Electrical Redundancy/Upgrade for Pumps	$426,391		Bulkheads *	$321,274
Bulkhead Change	$191,821		Diffuser Modifications *	$300,471
Modify Diffuser Openings	$175,178		Auxiliary Water Pump Crane	$2,073,438
Crane to Handle Pumps /Bulkheads	$1,658,750		Fishway Entrance Hoist	$195,289
Fishway Entrance Hoist	$156,231		2 (Upgrade Existing Pumps and System Improvements)	$4,797,941
Alternative 2	$3,838,353	25	Upgrade Existing Pumps *	$1,098,384
Dewater Ladder Area	$129,837		Electrical Upgrade and Redundancy	$875,916
Upgrade Pumps for Reliability	$835,428		Bulkheads *	$292,848
Electrical Redundancy/Upgrade for Pumps	$700,733		Diffuser Modifications *	$271,799
Bulkhead Change	$190,999		Auxiliary Water Pump Crane	$2,064,544
Modify Diffuser Openings	$174,160		Fishway Entrance Hoist	$194,451
Crane to Handle Pumps /Bulkheads	$1,651,635		3 (Gravity Supply System and System Improvements)	$7,315,475
Fishway Entrance Hoist	$155,561		Gravity Supply System (total)	$4,104,805
Alternative 3 a	$6,096,229	20	Intake System (Cylindrical Tee Screen)	$1,541,555
Dewater Ladder Area	$129,759		Supply Pipe Connection (Cone Valve) *	$2,563,250
Intake Structure (T-Screens Type)	$1,284,629		Electrical Upgrade and Redundancy	$500,258
Water Transport Str (Cone Type)	$1,808,979		Bulkheads *	$280,964
Access Crane (For Cone Valve)	$283,810		Diffuser Modifications *	$262,117
Electrical Upgrade for Pumps	$416,882		Auxiliary Water Pump Crane	$1,980,769
Bulkhead Change	$190,884		Fishway Entrance Hoist	$186,560
Modify Diffuser Openings	$175,178		* Cost of dewatering the ladder area for each alternative is	
Crane to Handle Pumps /Bulkheads	$1,650,641		equally divided between these line items for each alternative.	
Fishway Entrance Hoist	$155,467			

APPENDIX E

Construction Cost Estimates - Ice Harbor South Shore Fishway

EMERGENCY AUX WATER SUPPLY
Snake River & Washington
*** Price Level 1 Oct. 1999 ***

Designed By: Walla Walla District COE
Estimated By: Karl Pankaskie/Garth Clausen

Prepared By: Walla Walla, Cost Engineering Br
Kim Callan, Branch Chief

Preparation Date: 09/17/99
Effective Date of Pricing: 09/17/99
Est Construction Time: 200 Days

Sales Tax: 7.90%

Currency in DOLLARS

CODE BFL?? CONTRACT ?

**** TOTAL CONTRACT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: ICE HARBOR LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

	CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99					AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99				........FULLY FUNDED ESTIMATE........				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
04.01.99	ICE HARBOR DAM - ALT 1 - South Shore ELECTRICA UPGRADE & RED AUXILIARY WATER SUPPLY SYSTEM TECHNICAL REPORT DATED # AUGUST 1999	1,484	371	25%	1,855		1,484	371	1,855	1 QTR 04	13.7%	1,687	422	2,109
	TOTAL CONSTRUCTION COSTS ===>	1,484	371	25%	1,855		1,484	371	1,855			1,687	422	2,109
01---	LANDS AND DAMAGES													
22---	FEASIBILITY STUDIES													
30---	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	40	11	25%	51		40	11	51	3 QTR 00	4.6%	42	11	53
1.0%	Planning & Environmental Compliance	16	4	25%	20		16	4	20	3 QTR 00	4.6%	17	4	21
15.0%	Engineering & Design	242	60	25%	302		242	60	302	3 QTR 00	4.6%	253	63	316
1.0%	Engineering Tech Review & VE	16	4	25%	20		16	4	20	3 QTR 00	4.6%	17	4	21
1.0%	Contracting & Reprographics	16	4	25%	20		16	4	20	3 QTR 00	4.6%	17	4	21
3.0%	Engineering During Construction	44	11	25%	55		44	11	55	1 QTR 04	13.7%	50	13	63
0.5%	Project Operation:	9	2	25%	11		9	2	11	3 QTR 00	4.6%	9	2	11
31---	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	149	37	25%	186		149	37	186	1 QTR 04	13.7%	169	42	211
2.0%	Project Operation:	30	7	25%	37		30	7	37	1 QTR 04	13.7%	34	8	42
2.5%	Project Management	37	10	25%	47		37	10	47	1 QTR 04	13.7%	42	11	53
	TOTAL COSTS ================>	2,083	521	25%	2,604		2,083	521	2,604			2,337	584	2,921
06.2--	ICE HARBOR DAM - ALT 1 - South Shore GOVERNMENT FURNISH MATERIALS													
30---	PLANNING, ENGINEERING & DESIGN													
15.0%	Engineering & Design													
1.0%	Contracting & Reprographics													
	TOTAL GFS COSTS =====>													

U.S. Army Corps of Engineers
PROJECT AUXIH7: EMERGENCY AUX WATER SUPPLY - Snake River & Washington
Ice Habor Alt #1, South Shore Estimate 9/17/99
** PROJECT INDIRECT SUMMARY - BID ITEM **

	QUANTITY	UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
GG ALT #1 ELEC UPGRATE & RED. SS										
GG.04 DAMS - SOUTH SHORE - ICE HARBOR										
GG.04.01 MAIN DAM										
GG.04.01.99 ASSOCIATED GENERAL ITEMS										
GG.04.01.99|006- ELECTRICAL UPGRADE FOR PUMPS	8.00	EA	1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	185545.47
TOTAL ASSOCIATED GENERAL ITEMS	3.00	EA	1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	494787.92
TOTAL MAIN DAM			1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	
TOTAL DAMS - SOUTH SHORE - ICE HARBOR	1.00	EA	1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	1484364
TOTAL ALT #1 ELEC UPGRATE & RED. SS			1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
GG ALT #1 ELEC UPGRATE & RED. SS									
GG.04 DAMS - SOUTH SHORE - ICE HARBOR									
GG.04.01 MAIN DAM									
GG.04.01.99 ASSOCIATED GENERAL ITEMS									
GG.04.01.99|006- ELECTRICAL UPGRADE FOR PUMPS									
GG.04.01.99|006--A16A Motor Starters and Assoc.	8.00 EA	643,686	77,242	64,884	78,581	43,220	7,586	915,198	114399.81
GG.04.01.99|006--B16B Existing Switchgears Removal	11.00 EA	20,585	2,470	2,075	2,513	1,382	243	29,268	2660.70
GG.04.01.99|006--C16C Install Outside Switchgear	14.00 EA	343,130	41,176	34,588	41,889	23,039	4,044	487,866	34847.56
GG.04.01.99|006--D16D Misc. Work - Controls Interties	12.00 EA	36,595	4,391	3,689	4,468	2,457	431	52,032	4335.98
TOTAL ELECTRICAL UPGRADE FOR PUMPS	8.00 EA	1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	185545.47
TOTAL ASSOCIATED GENERAL ITEMS	3.00 EA	1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	494787.92
TOTAL MAIN DAM		1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	
TOTAL DAMS - SOUTH SHORE - ICE HARBOR	1.00 EA	1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	1484364
TOTAL ALT #1 ELEC UPGRATE & RED. SS		1,043,996	125,280	105,235	127,451	70,098	12,304	1,484,364	

APPENDIX F

Construction Cost Estimates - Lower Monumental

EMERGENCY AUX WATER SUPPLY
Snake River & Washington
*** Price Level 1 Oct. 1999 ***

Designed By: Walla Walla District COE
Estimated By: Karl Pankaskie/Garth Clausen

Prepared By: Walla Walla, Cost Engineering Br
Kim Callan, Branch Chief

Preparation Date: 09/17/99
Effective Date of Pricing: 09/17/99
Est Construction Time: 200 Days

Sales Tax: 7.90%

M C A C E S G O L D E D I T I O N

Release 5.30

LABOR ID: EWWW99 EQUIP ID: NAT97C

Currency in DOLLARS

CREW ID: NAT97A UPB ID: NAT97D

CODE BFL?? CONTRACT ? **** TOTAL CONTRACT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY — DISTRICT: Walla Walla

LOCATION: LOWER MONUMENTAL LOCK AND DAM, SNAKE RIVER — P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

		CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99				AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99				.........FULLY FUNDED ESTIMATE.........				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
	LOWER MONUMENTAL DAM - ALT 1 - South Shore PUMP SYSTEM													
04.01.99	AUXILIARY WATER SUPPLY SYSTEM	4,817	1,204	25%	6,021		4,817	1,204	6,021	1 QTR 02	8.0%	5,203	1,300	6,503
	TECHNICAL REPORT DATED # AUGUST 1999													
	TOTAL CONSTRUCTION COSTS ===>	4,817	1,204	25%	6,021		4,817	1,204	6,021			5,203	1,300	6,503
01---	LANDS AND DAMAGES													
22---	FEASIBILITY STUDIES													
30---	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	124	32	25%	156		124	32	156	3 QTR 00	4.6%	130	33	163
1.0%	Planning & Environmental Compliance	50	12	25%	62		50	12	62	3 QTR 00	4.6%	52	13	65
15.0%	Engineering & Design	745	186	25%	931		745	186	931	3 QTR 00	4.6%	780	195	975
1.0%	Engineering Tech Review & VE	50	12	25%	62		50	12	62	3 QTR 00	4.6%	52	13	65
1.0%	Contracting & Reprographics	50	12	25%	62		50	12	62	3 QTR 00	4.6%	52	13	65
3.0%	Engineering During Construction	144	36	25%	180		144	36	180	1 QTR 02	8.0%	156	39	195
0.5%	Project Operation:	25	7	25%	32		25	7	32	3 QTR 00	4.6%	26	7	33
31---	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	481	120	25%	601		481	120	601	1 QTR 02	8.0%	520	130	650
2.0%	Project Operation:	96	24	25%	120		96	24	120	1 QTR 02	8.0%	104	26	130
2.5%	Project Management	120	31	25%	151		120	31	151	1 QTR 02	8.0%	130	33	163
	TOTAL COSTS ================>	6,702	1,676	25%	8,378		6,702	1,676	8,378			7,205	1,802	9,007
	LOWER MONUMENTAL DAM - ALT 1 - South Shore													
04.01.99	GOVERNMENT FURNISH MATERIALS													
30---	PLANNING, ENGINEERING & DESIGN													
15.0%	Engineering & Design													
1.0%	Contracting & Reprographics													
	TOTAL GFS COSTS =====>													
	MISC COSTS FOR ALL PROJECTS													
18---	CULTURAL RESOURCES													
30---	ANOTHER MISC E & D COSTS													

U.S. Army Corps of Engineers
PROJECT AUXIH7: EMERGENCY AUX WATER SUPPLY - Snake River & Washington
L Monumental Alt #1,South Shore Estimate 9/17/99
** PROJECT INDIRECT SUMMARY - BID ITEM **

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
KK ALT #1 PUMP SYSTEM SS									
KK.04 DAMS - SOUTH SHORE - MONUMENTAL									
KK.04.01 MAIN DAM									
KK.04.01.99 ASSOCIATED GENERAL ITEMS									
KK.04.01.99|000- DEWATER LADDER AREA		232,217	27,866	23,407	28,349	15,592	2,194	329,626	
KK.04.01.99|001- NEW PUMPING SYSTEM	1.00 EA	2,382,088	285,851	240,114	290,805	159,943	22,510	3,381,311	3381311
KK.04.01.99|002- CRANE TO HANDLE PUMPS/BULKHEADS	1.00 EA	504,000	60,480	50,803	61,528	33,841	4,763	715,415	715414.74
KK.04.01.99|003- MOD FISH CONTROL SYS OPERATE IND	1.00 EA	274,912	32,989	27,711	33,561	18,459	2,598	390,230	390229.76
TOTAL ASSOCIATED GENERAL ITEMS	3.00 EA	3,393,217	407,186	342,036	414,244	227,834	32,065	4,816,582	1605527
TOTAL MAIN DAM		3,393,217	407,186	342,036	414,244	227,834	32,065	4,816,582	
TOTAL DAMS - SOUTH SHORE - MONUMENTAL	1.00 EA	3,393,217	407,186	342,036	414,244	227,834	32,065	4,816,582	4816582
TOTAL ALT #1 PUMP SYSTEM SS		3,393,217	407,186	342,036	414,244	227,834	32,065	4,816,582	

<table>
<tr><th></th><th></th><th>QUANTITY UOM</th><th>TOTAL DIRECT</th><th>FOOH</th><th>HOOH</th><th>PROF</th><th>MOB/DEMB</th><th>BOND</th><th>TOTAL COST</th><th>UNIT COST</th></tr>
<tr><td>KK</td><td>ALT #1 PUMP SYSTEM SS</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>KK.04</td><td>DAMS - SOUTH SHORE - MONUMENTAL</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>KK.04.01</td><td>MAIN DAM</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>KK.04.01.99</td><td>ASSOCIATED GENERAL ITEMS</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>KK.04.01.99|000-</td><td>DEWATER LADDER AREA</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>KK.04.01.99|000--01--</td><td>DEWATER - FISH LADDER TT</td><td>1.00 TT</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0.01</td></tr>
<tr><td>KK.04.01.99|000--01AA</td><td>Dewater Area</td><td></td><td>5,814</td><td>698</td><td>586</td><td>710</td><td>390</td><td>55</td><td>8,253</td><td></td></tr>
<tr><td>KK.04.01.99|000--01MA</td><td>Pump Water out</td><td>60.00 DAY</td><td>72,122</td><td>8,655</td><td>7,270</td><td>8,805</td><td>4,843</td><td>682</td><td>102,375</td><td>1706.25</td></tr>
<tr><td>KK.04.01.99|000--01ZZ</td><td>Water Up Area</td><td></td><td>5,447</td><td>654</td><td>549</td><td>665</td><td>366</td><td>51</td><td>7,732</td><td></td></tr>
<tr><td>KK.04.01.99|000--A0--</td><td>DEWATER - PUMP PLANT SITE TT</td><td>1.00 TT</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0.01</td></tr>
<tr><td>KK.04.01.99|000--A03M</td><td>Bulkhead Fab. Costs</td><td>1.00 EA</td><td>88,602</td><td>10,632</td><td>8,931</td><td>10,817</td><td>5,949</td><td>837</td><td>125,768</td><td>125768.04</td></tr>
<tr><td>KK.04.01.99|000--005B</td><td>Install Wall Anchors for Forms</td><td>1.00 EA</td><td>13,832</td><td>1,660</td><td>1,394</td><td>1,689</td><td>929</td><td>131</td><td>19,634</td><td>19634.39</td></tr>
<tr><td>KK.04.01.99|000--005C</td><td>Install Bulkhead Forms & Dewater</td><td>1.00 EA</td><td>25,436</td><td>3,052</td><td>2,564</td><td>3,105</td><td>1,708</td><td>240</td><td>36,105</td><td>36105.05</td></tr>
<tr><td>KK.04.01.99|000--005Q</td><td>Remove BH-Forms & Cutoff Anchors</td><td>1.00 EA</td><td>20,964</td><td>2,516</td><td>2,113</td><td>2,559</td><td>1,408</td><td>198</td><td>29,758</td><td>29757.86</td></tr>
<tr><td></td><td>TOTAL DEWATER LADDER AREA</td><td></td><td>232,217</td><td>27,866</td><td>23,407</td><td>28,349</td><td>15,592</td><td>2,194</td><td>329,626</td><td></td></tr>
<tr><td>KK.04.01.99|001-</td><td>NEW PUMPING SYSTEM</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>KK.04.01.99|001--02AC</td><td>Excavation and Level Site</td><td>250.00 CY</td><td>1,863</td><td>224</td><td>188</td><td>227</td><td>125</td><td>18</td><td>2,644</td><td>10.58</td></tr>
<tr><td>KK.04.01.99|001--02BC</td><td>Structural Backfill</td><td>2050.00 CY</td><td>19,545</td><td>2,345</td><td>1,970</td><td>2,386</td><td>1,312</td><td>185</td><td>27,744</td><td>13.53</td></tr>
<tr><td>KK.04.01.99|001--02CC</td><td>Drilling Rock Anchor Holes</td><td>875.00 LF</td><td>30,358</td><td>3,643</td><td>3,060</td><td>3,706</td><td>2,038</td><td>287</td><td>43,093</td><td>49.25</td></tr>
<tr><td>KK.04.01.99|001--02CD</td><td>Placing & Tension Rock Anchors</td><td>35.00 EA</td><td>5,140</td><td>617</td><td>518</td><td>627</td><td>345</td><td>49</td><td>7,296</td><td>208.45</td></tr>
<tr><td>KK.04.01.99|001--02CE</td><td>Grout Rock Anchor</td><td>35.00 EA</td><td>3,375</td><td>405</td><td>340</td><td>412</td><td>227</td><td>32</td><td>4,790</td><td>136.87</td></tr>
<tr><td>KK.04.01.99|001--02CG</td><td>Cut Hole in Concrete Wall 10'Dia</td><td>1.00 LF</td><td>7,572</td><td>909</td><td>763</td><td>924</td><td>508</td><td>72</td><td>10,749</td><td>10748.71</td></tr>
<tr><td>KK.04.01.99|001--03AC</td><td>Concrete Foundation Slab</td><td>205.00 CY</td><td>66,695</td><td>8,003</td><td>6,723</td><td>8,142</td><td>4,478</td><td>630</td><td>94,672</td><td>461.81</td></tr>
<tr><td>KK.04.01.99|001--03AD</td><td>Concrete Walls</td><td>545.00 CY</td><td>278,799</td><td>33,456</td><td>28,103</td><td>34,036</td><td>18,720</td><td>2,635</td><td>395,747</td><td>726.14</td></tr>
<tr><td>KK.04.01.99|001--03AF</td><td>Concrete Elevated Slabs</td><td>100.00 CY</td><td>48,725</td><td>5,847</td><td>4,911</td><td>5,948</td><td>3,272</td><td>460</td><td>69,164</td><td>691.64</td></tr>
<tr><td>KK.04.01.99|001--03AH</td><td>Concrete Thrust Block</td><td>25.00 CY</td><td>3,237</td><td>388</td><td>326</td><td>395</td><td>217</td><td>31</td><td>4,595</td><td>183.82</td></tr>
<tr><td>KK.04.01.99|001--03AK</td><td>Grout Pipe into Wall</td><td>5.00 CY</td><td>2,003</td><td>240</td><td>202</td><td>245</td><td>134</td><td>19</td><td>2,843</td><td>568.66</td></tr>
<tr><td>KK.04.01.99|001--05AC</td><td>Metal Gratings & Supports</td><td>300.00 SF</td><td>10,734</td><td>1,288</td><td>1,082</td><td>1,310</td><td>721</td><td>101</td><td>15,237</td><td>50.79</td></tr>
<tr><td>KK.04.01.99|001--05AD</td><td>Metal Intake Screens</td><td>365.00 SF</td><td>64,441</td><td>7,733</td><td>6,496</td><td>7,867</td><td>4,327</td><td>609</td><td>91,472</td><td>250.61</td></tr>
<tr><td>KK.04.01.99|001--05AE</td><td>Metal Intake Bulkhead & Guides</td><td>45000.00 LB</td><td>92,746</td><td>11,130</td><td>9,349</td><td>11,322</td><td>6,227</td><td>876</td><td>131,651</td><td>2.93</td></tr>
<tr><td>KK.04.01.99|001--05AF</td><td>Metal Intake Juv. Fish Screens</td><td>1750.00 SF</td><td>375,297</td><td>45,036</td><td>37,830</td><td>45,816</td><td>25,199</td><td>3,546</td><td>532,725</td><td>304.41</td></tr>
<tr><td>KK.04.01.99|001--05AG</td><td>Metal Handrailing</td><td>30.00 LF</td><td>1,962</td><td>235</td><td>198</td><td>239</td><td>132</td><td>19</td><td>2,785</td><td>92.82</td></tr>
<tr><td>KK.04.01.99|001--15AC</td><td>Intake Pump 600 Hp 700Cfs 5'Head</td><td>1.00 EA</td><td>795,673</td><td>95,481</td><td>80,204</td><td>97,136</td><td>53,425</td><td>7,519</td><td>1,129,437</td><td>1129437</td></tr>
<tr><td>KK.04.01.99|001--15AE</td><td>Intake 130" Piping & 120"B-Valve</td><td>80.00 LF</td><td>500,177</td><td>60,021</td><td>50,418</td><td>61,062</td><td>33,584</td><td>4,727</td><td>709,988</td><td>8874.85</td></tr>
<tr><td>KK.04.01.99|001--15QA</td><td>Screen Cleaner:Dewatering Screen</td><td>1.00 EA</td><td>28,656</td><td>3,439</td><td>2,888</td><td>3,498</td><td>1,924</td><td>271</td><td>40,676</td><td>40675.89</td></tr>
<tr><td>KK.04.01.99|001--16QA</td><td>Screen Cleaner:Electrical</td><td>1.00 EA</td><td>45,091</td><td>5,411</td><td>4,545</td><td>5,505</td><td>3,028</td><td>426</td><td>64,005</td><td>64004.85</td></tr>
<tr><td></td><td>TOTAL NEW PUMPING SYSTEM</td><td>1.00 EA</td><td>2,382,088</td><td>285,851</td><td>240,114</td><td>290,805</td><td>159,943</td><td>22,510</td><td>3,381,311</td><td>3381311</td></tr>
<tr><td>KK.04.01.99|002-</td><td>CRANE TO HANDLE PUMPS/BULKHEADS</td><td>1.00 EA</td><td>504,000</td><td>60,480</td><td>50,803</td><td>61,528</td><td>33,841</td><td>4,763</td><td>715,415</td><td>715414.74</td></tr>
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	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
KK.04.01.99|003- MOD FISH CONTROL SYS OPERATE IND									
KK.04.01.99|003--16AA Mod Fish Control, Breaker	1.00 EA	154,853	18,582	15,609	18,905	10,397	1,463	219,810	219810.41
KK.04.01.99|003--16AB Mod Fish Control,Switch Gears	3.00 EA	107,927	12,951	10,879	13,176	7,247	1,020	153,200	51066.51
KK.04.01.99|003--16AC Mod Fish Control,Sec. Conductors	300.00 LF	2,556	307	258	312	172	24	3,628	12.09
KK.04.01.99|003--16ED Electrical Programing		9,575	1,149	965	1,169	643	90	13,592	
TOTAL MOD FISH CONTROL SYS OPERATE IND	1.00 EA	274,912	32,989	27,711	33,561	18,459	2,598	390,230	390229.76
TOTAL ASSOCIATED GENERAL ITEMS	3.00 EA	3,393,217	407,186	342,036	414,244	227,834	32,065	4,816,582	1605527
TOTAL MAIN DAM		3,393,217	407,186	342,036	414,244	227,834	32,065	4,816,582	
TOTAL DAMS - SOUTH SHORE - MONUMENTAL	1.00 EA	3,393,217	407,186	342,036	414,244	227,834	32,065	4,816,582	4816582
TOTAL ALT #1 PUMP SYSTEM SS		3,393,217	407,186	342,036	414,244	227,834	32,065	4,816,582	

EMERGENCY AUX WATER SUPPLY
Snake River & Washington
*** Price Level 1 Oct. 1999 ***

Designed By: Walla Walla District COE
Estimated By: Karl Pankaskie/Garth Clausen

Prepared By: Walla Walla, Cost Engineering Br
Kim Callan, Branch Chief

Preparation Date: 09/17/99
Effective Date of Pricing: 09/17/99
Est Construction Time: 200 Days

Sales Tax: 7.90%

Currency in DOLLARS

LABOR ID: EWWW99 EQUIP ID: NAT97C CREW ID: NAT97A UPB ID: NAT97D

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: LOWER MONUMENTAL LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

	CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99					AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99				........FULLY FUNDED ESTIMATE........				
ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
	LOWER MONUMENTAL DAM - ALT 2 - South Shore GRAVITY SYSTEM													
04.01.99	AUXILIARY WATER SUPPLY SYSTEM TECHNICAL REPORT DATED # AUGUST 1999	3,862	966	25%	4,828		3,862	966	4,828	1 QTR 02	8.0%	4,171	1,043	5,214
	TOTAL CONSTRUCTION COSTS ===>	3,862	966	25%	4,828		3,862	966	4,828			4,171	1,043	5,214
01---	LANDS AND DAMAGES													
22---	FEASIBILITY STUDIES													
30---	PLANNING, ENGINEERING & DESIGN													
2.5%	Project Management	99	25	25%	124		99	25	124	3 QTR 00	4.6%	104	26	130
1.0%	Planning & Environmental Compliance	40	10	25%	50		40	10	50	3 QTR 00	4.6%	42	10	52
15.0%	Engineering & Design	598	149	25%	747		598	149	747	3 QTR 00	4.6%	626	156	782
1.0%	Engineering Tech Review & VE	40	10	25%	50		40	10	50	3 QTR 00	4.6%	42	10	52
1.0%	Contracting & Reprographics	40	10	25%	50		40	10	50	3 QTR 00	4.6%	42	10	52
3.0%	Engineering During Construction	116	29	25%	145		116	29	145	1 QTR 02	8.0%	125	31	156
0.5%	Project Operation:	20	5	25%	25		20	5	25	3 QTR 00	4.6%	21	5	26
31---	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	386	96	25%	482		386	96	482	1 QTR 02	8.0%	417	104	521
2.0%	Project Operation:	77	19	25%	96		77	19	96	1 QTR 02	8.0%	83	21	104
2.5%	Project Management	96	24	25%	120		96	24	120	1 QTR 02	8.0%	104	26	130
	TOTAL COSTS ================>	5,374	1,343	25%	6,717		5,374	1,343	6,717			5,777	1,442	7,219
	LOWER MONUMENTAL DAM - ALT 2 - South Shore													
04.01.99	GOVERNMENT FURNISH MATERIALS													
30---	PLANNING, ENGINEERING & DESIGN													
15.0%	Engineering & Design													
1.0%	Contracting & Reprographics													
	TOTAL GFS COSTS =====>													

	QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
LL ALT #2 GRAVITY FEED SS									
LL.04 DAMS - SOUTH SHORE - MONUMENTAL									
LL.04.01 MAIN DAM									
LL.04.01.99 ASSOCIATED GENERAL ITEMS									
LL.04.01.99|000- DEWATER LADDER AREA		83,384	10,006	8,405	10,179	5,599	823	118,396	
LL.04.01.99|001- INTAKE STRUCTURE		0	0	0	0	0	0	0	
LL.04.01.99|001D DRUM INTAKE SCREEN		1,089,349	130,722	109,806	132,988	73,143	10,751	1,546,759	
LL.04.01.99|002B WATER TRANSPORT STR(INLINE SLEEV		1,347,247	161,670	135,802	164,472	90,460	13,296	1,912,947	
LL.04.01.99|002X ACCESS CRANE FOR SLEEVE VALVE	1.00 EA	200,000	24,000	20,160	24,416	13,429	1,974	283,979	283978.62
TOTAL ASSOCIATED GENERAL ITEMS		2,719,979	326,398	274,174	332,055	182,630	26,844	3,862,080	
TOTAL MAIN DAM		2,719,979	326,398	274,174	332,055	182,630	26,844	3,862,080	
TOTAL DAMS - SOUTH SHORE - MONUMENTAL	1.00 EA	2,719,979	326,398	274,174	332,055	182,630	26,844	3,862,080	3862080
TOTAL ALT #2 GRAVITY FEED SS		2,719,979	326,398	274,174	332,055	182,630	26,844	3,862,080	

		QUANTITY	UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
LL	ALT #2 GRAVITY FEED SS										
LL.04	DAMS - SOUTH SHORE - MONUMENTAL										
LL.04.01	MAIN DAM										
LL.04.01.99	ASSOCIATED GENERAL ITEMS										
LL.04.01.99|000-	DEWATER LADDER AREA										
LL.04.01.99|000--01--	DEWATER - FISH LADDER TT	1.00	TT	0	0	0	0	0	0	0	0.01
LL.04.01.99|000--01AA	Dewater Area			5,814	698	586	710	390	57	8,256	
LL.04.01.99|000--01MA	Pump Water out	60.00	DAY	72,122	8,655	7,270	8,805	4,843	712	102,405	1706.76
LL.04.01.99|000--01ZZ	Water Up Area			5,447	654	549	665	366	54	7,734	
	TOTAL DEWATER LADDER AREA			83,384	10,006	8,405	10,179	5,599	823	118,396	
LL.04.01.99|001-	INTAKE STRUCTURE			0	0	0	0	0	0	0	
LL.04.01.99|001D	DRUM INTAKE SCREEN										
LL.04.01.99|001D-2000	METAL DRUM INTAKE SCREEN TT	1.00	EA	0	0	0	0	0	0	0	0.01
LL.04.01.99|001D-202D	Intake Anchors Bolts Installatn	36.00	EA	16,983	2,038	1,712	2,073	1,140	168	24,114	669.85
LL.04.01.99|001D-205A	Intake Support Frame Installatn	20000.00	LB	97,445	11,693	9,822	11,896	6,543	962	138,361	6.92
LL.04.01.99|001D-205D	Intake Valve/Sleeve Coupling Ass	1.00	EA	313,575	37,629	31,608	38,281	21,055	3,095	445,243	445242.92
LL.04.01.99|001D-205F	Intake Drum Screen Assemble	2180.00	SF	494,295	59,315	49,825	60,344	33,189	4,878	701,846	321.95
LL.04.01.99|001D-3000	METAL BACKFLUSH ASSEMBLES TT	1.00	EA	0	0	0	0	0	0	0	0.01
LL.04.01.99|001D-305A	Metal Backflush Piping & Valves	1.00	EA	76,703	9,204	7,732	9,364	5,150	757	108,909	108909.37
LL.04.01.99|001D-4000	METAL INTAKE AIR CONTROL SYS TT	1.00	EA	0	0	0	0	0	0	0	0.01
LL.04.01.99|001D-415C	Air Controlling Piping	400.00	LF	21,878	2,625	2,205	2,671	1,469	216	31,064	77.66
LL.04.01.99|001D-5000	INTAKE DRUM ROTATING MOTOR			0	0	0	0	0	0	0	
LL.04.01.99|001D-502B	Openning thru Upstream Parapet	10.00	LF	2,250	270	227	275	151	22	3,195	319.48
LL.04.01.99|001D-502D	Intake Anchors Bolts Installatn	16.00	EA	7,573	909	763	925	508	75	10,753	672.06
LL.04.01.99|001D-505D	Intake Motor Platform	50.00	SF	11,297	1,356	1,139	1,379	759	111	16,040	320.80
LL.04.01.99|001D-515A	Intake Motor & Driving Rod Not D			27,588	3,311	2,781	3,368	1,852	272	39,172	
LL.04.01.99|001D-516A	Intake Motor Electrical			19,763	2,372	1,992	2,413	1,327	195	28,061	
	TOTAL DRUM INTAKE SCREEN			1,089,349	130,722	109,806	132,988	73,143	10,751	1,546,759	
LL.04.01.99|002B	WATER TRANSPORT STR(INLINE SLEEV										
LL.04.01.99|002B--000	METAL BULKHEAD ASSEMBLY TT	1.00	EA	0	0	0	0	0	0	0	0.01
LL.04.01.99|002B--02C	Bulkhead Drill 2" Hole	43.00	LF	4,466	536	450	545	300	44	6,341	147.47
LL.04.01.99|002B--02D	Bulkhead Anchors Bolts Installtn	16.00	EA	7,905	949	797	965	531	78	11,225	701.54
LL.04.01.99|002B--05A	Bulkhead Metal & Install	40000.00	LB	110,884	13,306	11,177	13,537	7,445	1,094	157,443	3.94
LL.04.01.99|002B--15A	Bulkhead Metal Remove	1.00	EA	17,777	2,133	1,792	2,170	1,194	175	25,242	25241.94
LL.04.01.99|002B-1000	WATER LINE THROUGH THE DAM TT	1.00	EA	0	0	0	0	0	0	0	0.01
LL.04.01.99|002B-102A	Drill 91" Dia Hole into Dam	43.00	LF	196,510	23,581	19,808	23,990	13,194	1,939	279,022	6488.90
LL.04.01.99|002B-103A	Grout Pipe in Hole into Dam	11.00	CY	5,196	624	524	634	349	51	7,378	670.74

		QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
LL.04.01.99|002B-115A	84" Dia Water Supply Pipe Line	43.00 LF	35,639	4,277	3,592	4,351	2,393	352	50,603	1176.81
LL.04.01.99|002B-115B	12" Dia Backflush Pipe Line	43.00 LF	4,465	536	450	545	300	44	6,340	147.45
LL.04.01.99|002B-2000	WATER LINE (THE DRY SIDE DAM) TT	1.00 EA	0	0	0	0	0	0	0	0.01
LL.04.01.99|002B-202C	Upper Access Remove E-Concrete	225.00 SF	9,458	1,135	953	1,155	635	93	13,430	59.69
LL.04.01.99|002B-202F	Upper Access Door	1.00 EA	983	118	99	120	66	10	1,395	1395.29
LL.04.01.99|002B-205D	Upper Access Stairs & Platform	225.00 SF	38,338	4,601	3,864	4,680	2,574	378	54,436	241.94
LL.04.01.99|002B-205K	Pipe Support Piping, 12" Pipe	9.00 EA	21,643	2,597	2,182	2,642	1,453	214	30,731	3414.52
LL.04.01.99|002B-205M	Inital Anchor Block,for 84" Pipe	1.00 EA	7,193	863	725	878	483	71	10,214	10213.94
LL.04.01.99|002B-205N	Second Anchor Block,for 84" Pipe	1.00 EA	7,193	863	725	878	483	71	10,214	10213.94
LL.04.01.99|002B-215A	84" Dia Water Supply Pipe Line	160.00 LF	141,985	17,038	14,312	17,334	9,533	1,401	201,604	1260.02
LL.04.01.99|002B-215C	14" Dia Air Release Valve (SS)	1.00 EA	6,010	721	606	734	404	59	8,533	8532.97
LL.04.01.99|002B-215K	14 & 12" Dia Backflush Pipe Line	200.00 LF	21,296	2,556	2,147	2,600	1,430	210	30,238	151.19
LL.04.01.99|002B-215L	12" Dia Control Valve (Backflush	1.00 EA	22,367	2,684	2,255	2,731	1,502	221	31,759	31758.51
LL.04.01.99|002B-3000	WATER WELL (THE DRY SIDE DAM) TT	1.00 EA	0	0	0	0	0	0	0	0.01
LL.04.01.99|002B-302D	Exc & Install Well Pipe Casing	30.00 LF	52,663	6,320	5,308	6,429	3,536	520	74,776	2492.53
LL.04.01.99|002B-302G	Cutting Conc. Well Bottom Hole	1.00 EA	26,619	3,194	2,683	3,250	1,787	263	37,797	37796.69
LL.04.01.99|002B-303B	Concrete Cap on top Well Hole	30.00 CY	10,249	1,230	1,033	1,251	688	101	14,553	485.08
LL.04.01.99|002B-315D	65" Dia Inline Polyjet Valve	1.00 EA	566,616	67,994	57,115	69,173	38,045	5,592	804,534	804534.38
LL.04.01.99|002B-316A	Electrical for Sleeve Valve		31,790	3,815	3,204	3,881	2,135	314	45,139	
	TOTAL WATER TRANSPORT STR(INLINE SLEEV		1,347,247	161,670	135,802	164,472	90,460	13,296	1,912,947	
LL.04.01.99|002X	ACCESS CRANE FOR SLEEVE VALVE	1.00 EA	200,000	24,000	20,160	24,416	13,429	1,974	283,979	283978.62
	TOTAL ASSOCIATED GENERAL ITEMS		2,719,979	326,398	274,174	332,055	182,630	26,844	3,862,080	
	TOTAL MAIN DAM		2,719,979	326,398	274,174	332,055	182,630	26,844	3,862,080	
	TOTAL DAMS - SOUTH SHORE - MONUMENTAL	1.00 EA	2,719,979	326,398	274,174	332,055	182,630	26,844	3,862,080	3862080
	TOTAL ALT #2 GRAVITY FEED SS		2,719,979	326,398	274,174	332,055	182,630	26,844	3,862,080	

EMERGENCY AUX WATER SUPPLY
Snake River & Washington
*** Price Level 1 Oct. 1999 ***

Designed By: Walla Walla District COE
Estimated By: Karl Pankaskie/Garth Clausen

Prepared By: Walla Walla, Cost Engineering Br
Kim Callan, Branch Chief

Preparation Date: 09/17/99
Effective Date of Pricing: 09/17/99
Est Construction Time: 200 Days

Sales Tax: 7.90%

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M C A C E S   G O L D   E D I T I O N

Release 5.30

LABOR ID: EWWW99 EQUIP ID: NAT97C Currency in DOLLARS CREW ID: NAT97A UPB ID: NAT97D

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE TECHNICAL REPORT, DATED: 31 AUG 99

PROJECT: ADULT LADDER SYSTEMS EMERGENCY AUXILIARY WATER SUPPLY
LOCATION: LOWER MONUMENTAL LOCK AND DAM, SNAKE RIVER

DISTRICT: Walla Walla
P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

ACCOUNT NUMBER		FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: 31 AUG 99 EFFECTIVE PRICING LEVEL: 1 OCT 99 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: 2000 EFFECT. PRICING LEVEL: 1 OCT 99 OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	........FULLY FUNDED ESTIMATE........ FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
		LOWER MONUMENTAL DAM - ALT 3 - South Power House SUPPLY CONDUIT WITH IN-LINE PUMPS													
04.01.99		AUXILIARY WATER SUPPLY SYSTEM TECHNICAL REPORT DATED # AUGUST 1999	4,464	1,339	30%	5,803		4,464	1,339	5,803	1 QTR 02	8.0%	4,821	1,446	6,267
		TOTAL CONSTRUCTION COSTS ===>	4,464	1,339	30%	5,803		4,464	1,339	5,803			4,821	1,446	6,267
01---		LANDS AND DAMAGES													
22---		FEASIBILITY STUDIES													
30---		PLANNING, ENGINEERING & DESIGN													
	2.5%	Project Management	116	34	30%	150		116	34	150	3 QTR 00	4.6%	121	36	157
	1.0%	Planning & Environmental Compliance	46	14	30%	60		46	14	60	3 QTR 00	4.6%	48	15	63
	15.0%	Engineering & Design	691	207	30%	898		691	207	898	3 QTR 00	4.6%	723	217	940
	1.0%	Engineering Tech Review & VE	46	14	30%	60		46	14	60	3 QTR 00	4.6%	48	15	63
	1.0%	Contracting & Reprographics	46	14	30%	60		46	14	60	3 QTR 00	4.6%	48	15	63
	3.0%	Engineering During Construction	134	40	30%	174		134	40	174	1 QTR 02	8.0%	145	43	188
	0.5%	Project Operation:	23	7	30%	30		23	7	30	3 QTR 00	4.6%	24	7	31
31---		CONSTRUCTION MANAGEMENT													
	10.0%	Construction Management	446	134	30%	580		446	134	580	1 QTR 02	8.0%	482	145	627
	2.0%	Project Operation:	89	27	30%	116		89	27	116	1 QTR 02	8.0%	96	29	125
	2.5%	Project Management	112	33	30%	145		112	33	145	1 QTR 02	8.0%	121	36	157
		TOTAL COSTS ================>	6,213	1,863	30%	8,076		6,213	1,863	8,076			6,677	2,004	8,681
		LOWER MONUMENTAL DAM - ALT 3 - South Power House													
04.01.99		GOVERNMENT FURNISH MATERIALS													
30---		PLANNING, ENGINEERING & DESIGN													
	15.0%	Engineering & Design													
	1.0%	Contracting & Reprographics													
		TOTAL GFS COSTS =====>													

	QUANTITY	UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
MM ALT #3 S-CONDUIT/IN-LINE PUMPSSP										
MM.04 DAMS - SOUTH POWER HOUSE - MONUM										
MM.04.01 MAIN DAM - LOWER MONUMENTAL										
MM.04.01.99 ASSOCIATED GENERAL ITEMS										
MM.04.01.99|000- DEWATER LADDER AREA			83,384	10,006	8,405	10,179	5,599	799	118,372	
MM.04.01.99|001- CONTROL GATE	1.00	EA	349,352	41,922	35,215	42,649	23,457	3,348	495,943	495942.53
MM.04.01.99|002- NEW INTAKE	2.00	EA	710,752	85,290	71,644	86,769	47,723	6,812	1,008,989	504494.54
MM.04.01.99|003- NEW WATER SUPPLY PUMPS	3.00	EA	1,644,104	197,292	165,726	200,712	110,392	15,757	2,333,983	777994.28
MM.04.01.99|004- ELECTRICAL COST	1.00	JOB	356,792	42,815	35,965	43,557	23,956	3,419	506,505	506505.15
TOTAL ASSOCIATED GENERAL ITEMS			3,144,384	377,326	316,954	383,866	211,126	30,135	4,463,791	
TOTAL MAIN DAM - LOWER MONUMENTAL			3,144,384	377,326	316,954	383,866	211,126	30,135	4,463,791	
TOTAL DAMS - SOUTH POWER HOUSE - MONUM	1.00	EA	3,144,384	377,326	316,954	383,866	211,126	30,135	4,463,791	4463791
TOTAL ALT #3 S-CONDUIT/IN-LINE PUMPSSP			3,144,384	377,326	316,954	383,866	211,126	30,135	4,463,791	

		QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
MM ALT #3 S-CONDUIT/IN-LINE PUMPSSP										
MM.04 DAMS - SOUTH POWER HOUSE - MONUM										
MM.04.01 MAIN DAM - LOWER MONUMENTAL										
MM.04.01.99 ASSOCIATED GENERAL ITEMS										
MM.04.01.99|000- DEWATER LADDER AREA										
MM.04.01.99|000-01--	DEWATER - FISH LADDER TT	1.00 TT	0	0	0	0	0	0	0	0.01
MM.04.01.99|000--01AA	Dewater Area		5,814	698	586	710	390	56	8,254	
MM.04.01.99|000--01MA	Pump Water out	60.00 DAY	72,122	8,655	7,270	8,805	4,843	691	102,385	1706.42
MM.04.01.99|000--01ZZ	Water Up Area		5,447	654	549	665	366	52	7,733	
	TOTAL DEWATER LADDER AREA		83,384	10,006	8,405	10,179	5,599	799	118,372	
MM.04.01.99|001- CONTROL GATE										
MM.04.01.99|001--02AA	C-Gate, Sawcut & Remove Slab	1.00 EA	17,070	2,048	1,721	2,084	1,146	164	24,232	24232.32
MM.04.01.99|001--03AA	C-Gate, Concrete Sill Bottom	10.00 CY	6,458	775	651	788	434	62	9,168	916.85
MM.04.01.99|001--03BB	C-Gate,Grout Sill,Seal Pl,Guides	360.00 SF	9,024	1,083	910	1,102	606	86	12,810	35.58
MM.04.01.99|001--05AA	C-Gate, Hatch Cover Armor Steel	2800.00 LB	3,169	380	319	387	213	30	4,498	1.61
MM.04.01.99|001--05BC	C-Gate, Metal Guides, 2 each	44680.00 LB	162,027	19,443	16,332	19,780	10,879	1,553	230,014	5.15
MM.04.01.99|001--05CD	C-Gate, Str Metal Gate, 1 each	45660.00 LB	95,838	11,501	9,660	11,700	6,435	918	136,052	2.98
MM.04.01.99|001--15AA	C-Gate, Hydr Operator & Cylinder	1.00 EA	55,767	6,692	5,621	6,808	3,744	534	79,167	79166.95
	TOTAL CONTROL GATE	1.00 EA	349,352	41,922	35,215	42,649	23,457	3,348	495,943	495942.53
MM.04.01.99|002- NEW INTAKE										
MM.04.01.99|002--01AA	I-Temporary Constr - Cofferdam	2.00 EA	122,174	14,661	12,315	14,915	8,203	1,171	173,440	86719.76
MM.04.01.99|002--03AA	I-Concrete Removal-Blocks 14x17'	2.00 EA	172,723	20,727	17,411	21,086	11,597	1,655	245,199	122599.68
MM.04.01.99|002--05AA	Intake Bulkheads, Guides	24600.00 LB	72,221	8,666	7,280	8,817	4,849	692	102,525	4.17
MM.04.01.99|002--05AB	Intake Bulkheads, Grout Guides	360.00 SF	9,024	1,083	910	1,102	606	86	12,810	35.58
MM.04.01.99|002--05AC	Intake Bulkheads, 2 each	45860.00 LB	96,257	11,551	9,703	11,751	6,463	923	136,648	2.98
MM.04.01.99|002--05BA	Intake Trashracks, Guides	12400.00 LB	36,169	4,340	3,646	4,415	2,429	347	51,345	4.14
MM.04.01.99|002--05BB	Intake Trashracks, Grout Guides	360.00 SF	9,024	1,083	910	1,102	606	86	12,810	35.58
MM.04.01.99|002--05BC	Intake Trashracks, 2 each	2618.00 LB	54,950	6,594	5,539	6,708	3,690	527	78,008	29.80
MM.04.01.99|002--15AA	Intake Hydr Operators &Cylinders	2.00 EA	138,210	16,585	13,932	16,873	9,280	1,325	196,204	98102.11
	TOTAL NEW INTAKE	2.00 EA	710,752	85,290	71,644	86,769	47,723	6,812	1,008,989	504494.54
MM.04.01.99|003- NEW WATER SUPPLY PUMPS										
MM.04.01.99|003--01AA	Remove Existing Tainter Valve	1.00 EA	6,292	755	634	768	422	60	8,932	8932.04
MM.04.01.99|003--05AA	WS Pumps, Housing, Guides, Frame	1.00 JOB	130,599	15,672	13,164	15,943	8,769	1,252	185,399	185399.01

		QUANTITY UOM	TOTAL DIRECT	FOOH	HOOH	PROF	MOB/DEMB	BOND	TOTAL COST	UNIT COST
MM.04.01.99|003--05AB	WS Pumps, Winch 35ton	1.00 EA	74,686	8,962	7,528	9,118	5,015	716	106,025	106024.78
MM.04.01.99|003--15AB	WS Pumps, New Pumps 450HP	3.00 EA	1,432,527	171,903	144,399	174,883	96,186	13,729	2,033,627	677875.67
	TOTAL NEW WATER SUPPLY PUMPS	3.00 EA	1,644,104	197,292	165,726	200,712	110,392	15,757	2,333,983	777994.28
MM.04.01.99|004-	ELECTRICAL COST									
MM.04.01.99|004--16AB	Mod Fish Control, Breaker	1.00 EA	118,490	14,219	11,944	14,465	7,956	1,136	168,210	168209.61
MM.04.01.99|004--16AC	Mod Fish Control, Switch Gears	3.00 EA	206,109	24,733	20,776	25,162	13,839	1,975	292,593	97531.08
MM.04.01.99|004--16AD	Mod Fish Control, Sec.Conductors	300.00 LF	22,457	2,695	2,264	2,742	1,508	215	31,880	106.27
MM.04.01.99|004--16ED	Mod Fish Electrical Programing		9,737	1,168	981	1,189	654	93	13,822	
	TOTAL ELECTRICAL COST	1.00 JOB	356,792	42,815	35,965	43,557	23,956	3,419	506,505	506505.15
	TOTAL ASSOCIATED GENERAL ITEMS		3,144,384	377,326	316,954	383,866	211,126	30,135	4,463,791	
	TOTAL MAIN DAM - LOWER MONUMENTAL		3,144,384	377,326	316,954	383,866	211,126	30,135	4,463,791	
	TOTAL DAMS - SOUTH POWER HOUSE - MONUM	1.00 EA	3,144,384	377,326	316,954	383,866	211,126	30,135	4,463,791	4463791
	TOTAL ALT #3 S-CONDUIT/IN-LINE PUMPSSP		3,144,384	377,326	316,954	383,866	211,126	30,135	4,463,791	

Life-Cycle Cost Comparison for 3.04.b.(5)		
Filename: lccgf.xls		
Date: 9-20-99		
Based on 09/17/99 estimate		
INPUTS		
Alternative 2 Fully Funded Cost:	$7,219,000	
Alternative 3 Fully Funded Cost:	$8,681,000	
Cost Differential:	$1,462,000	
Alternative 2 Annual Energy Usage:	32,857	MW hours
Alternative 3 Annual Energy Usage:	7,258	MW hours
Energy Use Differential:	25,599	MW hours
Electrical Cost:	$17.45	per MW hour
OUTPUTS		
Annual Energy Cost Differential Between Alternative 3 and Alternative 2	$446,706	
Years to payback if Alternative 3 is chosen over Alternative 2	3.27	
Electrical Cost Based on PC-SAM model developed for the Ice Harbor Major Rehab Study. Energy value based in the year 2002. Average yearly value used.		

APPENDIX G

References

APPENDIX G

References

Engineer Regulation 200-2-2, 4 March 1998, *Environmental Quality Procedures for Implementing NEPA*.

Public Law 79-14 dated 2 March 1945, *Rivers and Harbors Act of 1945*.

____. 95-217, 1977, *Clean Water Act*.

____. 89-665, 1966, *National Historic Preservation Act*.

National Marine Fisheries Service, March 2, 1995. *Endangered Species Act - Section 7 Consultation, Biological Opinion*.

____. 1998. *Supplemental Biological Opinion, Operation of the Federal Snake River Power System*.

U.S. Army Corps of Engineers, Walla Walla District. 1995. *Lower Snake River, Adult Ladder Systems, Emergency Auxiliary Water Supply*.

____. 1998. *Fish Passage Plan* (FPP).

____. 1995. *Hydraulic Evaluation of Adult Fish Passage Facilities at Ice Harbor Dam*.

____. 1994. *Columbia River Salmon Mitigation Analysis System Configuration Study Phase I*.

____. 1988. *Hydraulic Evaluation of Adult Fish Passage Facilities at Little Goose, Lower Monumental, and McNary (South Shore) Dams*.

____. 1973. *Technical Report 109-1, Fish Ladders for Lower Monumental Dam, Snake River, Washington*.

APPENDIX H

O&M Backlog

U.S. ARMY CORPS OF ENGINEERS
WALLA WALLA DISTRICT
OPERATIONS DIVISION
FY 2000 BUDGET ITEMS

10. **Budget item UF-11 (IHR) - Rebuild South Fish Pumps Sump Unwatering Pump.** The unwatering pump for the fish pump sump is old and needs to be rebuilt so the fish pumps can continue to be unwatered for proper maintenance.

11. **Budget item UF-12 (IHR) - Repair Fishway Weir Gates.** The entrance weirs for the adult fishways are old and need to be rehabbed for continued operation. The gates need to be sandblasted, painted, and rollers replaced.

12. **Budget item UF-13 (IHR) - Overhaul Fish Pump Butterfly Valves.** The fish pumps have butterfly valves, which automatically close when the fish pumps turnoff to prevent water from flowing from the pump discharge chambers back through the pumps to the river. The butterfly valves are aged and need to be overhauled to ensure continued operation of the fishways.

13. **Budget item UF-14 (IHR) - Replace Hydraulic Actuator System on Fish Pumps.** The system is aged and worn and needs to be replaced to ensure proper operation of the fish pumps.

14. **Budget item UF-15 (IHR) - Powerfeed for South Shore Unwatering Pumps.** The electrical wiring for the south shore fishway unwatering pumps is aged and needs to be replaced for continued reliable operation.

15. **Budget Item UF-16 (IHR) - Rebuild Fish Pump Gearboxes.** The fish pump gearboxes are aged and need to be rebuilt. This action will rebuild 2 gearboxes per year with a span of 6 years required for rebuilding all of the gearboxes.

16. **Budget item UF-17 (IHR) - Rebuild North Shore Fish Pumps Sump Unwatering Pumps.** The unwatering pump for the fish pump sump is old and needs to be rebuilt so the fish pumps can be unwatered for proper maintenance.

17. **Budget item UF-18 (IHR) - Replace Fish Pump Farval Grease Units.** The greasing systems for the fish pumps are aged and need to be replaced for continued lubrication and operation of the fish pumps.

24. Budget item UF-26 (IHR) - Rehab Fishway Entrance Hoists. Hoists for the fishway entrances have aged and need to be rebuilt for continued operation of the adult fishways.

25. Budget item UF-27 (IHR) - Modify North Shore Adult Fishway Diffuser. The junction pool diffuser for the north shore fishway needs to be modified to eliminate flow restrictions within the auxiliary water supply system during low tailwater conditions.

26. Budget item UF-29 (IHR) - Crane for North Shore Fish Pumps. Ice Harbor does not have crane access for maintaining the north shore fish pumps. A gantry type crane needs to be installed over the fish pumps so fish pump components can be pulled for maintenance and replacement.

28. Budget item UF-31 (LMO) - Fish Collection Channel Unwatering Pump. An additional unwatering pump is required so the entire collection channel can be dewatered at one time for diffuser inspections and maintenance.

33. Budget item UF-37 (LMO) - Rehab Auxiliary Water Supply Pumps. The auxiliary water supply pumps are aging and need to removed and completely gone through, replacing worn parts. This action will do one pump per year for a period of three years.

34. Budget item UF-38 (LMO) - Juvenile Fish Facility Dewatering Drain Valve Pits. The valve pits for the juvenile fish facility are classified as confined spaces and require special procedures for performing maintenance on the valves. Replacing the valve pits with a valve room will eliminate the confined space requirements and allow better maintenance to be performed on the valves.

35. Budget item UF-39 (LMO) - Replace Fishway Entrance Hoist. One of the entrance hoists on the south shore is very old and difficult to maintain. Replacing the hoist will improve facility operations and improve reliability of the system.

36. Budget item UF-40 (LMO) - Rehab South Shore Auxiliary Water Regulating Gate. The gate controlling the flow of water from the north shore fishway to the south shore fishway is aging, requiring additional maintenance. The gate and its hydraulic cylinder need to be rebuilt.

38. Budget item UF-42 (LMO) - Spare Parts for Fish Pumps.
Funds to purchase spare parts for adult fish pumps including gearbox, impeller, bearings, and miscellaneous spare parts to comply with biological opinion requirements.

APPENDIX I

Correspondence

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
HYDROPOWER PROGRAM
525 NE Oregon Street
PORTLAND, OREGON 97232-2737

F/NWR5

FEB 25 1999

Mr. Kevin Crum
Project Manager
U.S. Army Corps of Engineers
Walla Walla District
201 North Third Avenue
Walla Walla, Washington 99362

RE: Review of 90% Submittal:
Lower Snake River Ice Harbor and Lower Monumental Projects Adult Ladder Systems Emergency Auxiliary Water Supply Phase II Technical Report

Dear Mr. Crum:

We have appreciated the opportunity to review the subject report. We are hereby providing our comments on the alternatives presented in the report. Mr. Larry Swenson presented these comments, except those covering Alternative 3 at Lower Monumental, during a meeting in your office on January 13, 1999. Mr. Van DeWitt provided the draft text for Alternative 3 on February 16, and we have included our comments on that alternative in this letter.

The bold text refers to the headings and sub-headings in the report. Our comments pertain to the report text under those headings.

SECTION 1 - INTRODUCTION

Incidental Take Statement (ITS) Number 16 of the 1995 Biological Opinion (BIOP) requires the Corps of Engineers to develop emergency auxiliary water supplies for all adult fishways where determined, in coordination with NMFS, to be necessary.

The BIOP did not specify what constitutes "emergency auxiliary water supplies." The Corps defined emergency supply as: spare hydraulic capacity above the maximum flow rate required by the Fish Passage Plan (FPP), equivalent to the flow rate of one AWS pump. This could be achieved by:

a.) providing a separate stand-alone system such as a gravity feed system or new pumping plant, or

b.) improving the reliability and performance of the existing systems which would have the effect of increasing the stand-by capacity, or

c.) a combination of the above.

This approach seems practical and reasonable and would result in a very high level of reliability for the AWS systems.

SECTION 2 - ICE HARBOR

2.04 NORTH SHORE SYSTEM IMPROVEMENTS

a. Alternative 1 (Criteria Revision with No Water Supply Additions, Upgrade Electrical and Improve Systems)

and

e. Alternative 5 (Reduce Entrance Width, Upgrade Electrical and Improve Systems)

The objective of this study is to improve the reliability of the AWS system to meet existing Fish Passage Plan (FPP) criteria. Our goal should be to provide the flows required to meet both the submergence and head requirements as stated in the FPP. Both of these alternatives would provide standby capacity, but at reduced flow rates. This would be contrary to the intent of the study.

b. Alternative 2 (Upgrade Existing Pumps, Upgrade Electrical and Improve Systems)

This is a well-though out alternative. This alternative fully meets the study goals for achieving FPP criteria and providing additional mechanical and electrical reliability. At this time, we believe this is the best north shore alternative.

Enlarging the openings to diffuser No. 1 would increase the efficiency of the Alternative 2 pumping system. It is also a strategy that could be used with the existing pumps. How much more flow could we get from the existing pumps if we enlarged the openings into diffuser No. 1? A detailed hydraulic analysis of the AWS system would be required prior to installing larger pumps and/or modifying the diffuser system.

c. Alternative 3 (Add Gravity Supply, Upgrade Electrical, and Improve Systems)

The proposed alternative would provide 500 cfs. Based on Table 2-4, 683 cfs is required to meet FPP criteria under some tailwater conditions. Therefore, it would still be necessary to run one of

the AWS pumps to meet FPP criteria. The basis for selecting 500 cfs as the design flow rate was not made clear. A case could be made for the following design discharges:

Design Q = 250 cfs	The gravity system could be designed as a backup for one of the existing AWS pumps.
Design Q = 700 cfs	The gravity system could be designed as a stand-alone backup for all of the AWS pumps.

There are several main concerns with this alternative:

a) The mechanical complexity is excessive.

b) The O&M requirements would be impractical.

c) Setting and maintaining proper flow balance would be very difficult.

d) It is questionable whether air-burst cleaning of fish screens would be effective.

e) There is insufficient current in the forebay near the screens to effectively transport the material removed from the screens.

f) There is concern that the sleeve valve will induce excessive vibration/noise in the water supply conduit. This could lead to additional delay of adult salmon and steelhead.

A traveling screen system, similar to that on the Oregon shore at McNary, may be a more appropriate approach for this screening application.

2.07. SOUTH SHORE SYSTEM IMPROVEMENT ALTERNATIVES

a. Alternative 1 (Electrical System Upgrade)

and

b. Alternative 2 (Improve Reliability through Enhanced Preventive Maintenance and Increased Spare Parts Inventory)

Neither of these alternatives is a substitute for the other. All of the work items in each of the alternatives should be performed. As with North Shore Alternative 2, these alternatives should also include rehabilitation of all key fishway appurtenances, such as entrance gates and hoists, controls, and diffusers, as required.

SECTION 3 - LOWER MONUMENTAL

3.04 SYSTEM IMPROVEMENT ALTERNATIVES

a. Alternative 1 (South Shore Pumping System)

We believe this alternative has significant merit because it would:

a. allow isolation of the south shore system from the north shore system, and

b. require only 2 pumps to be operated (instead of 3) in the north shore system, thus providing one spare pump, and

c. eliminate the complexities of a gravity-based system.

A screening system would be required to prevent entrainment of juvenile fish if the intake were constructed at the location and elevation shown on Plate 25. Since the existing AWS intakes are not screened, and do not appear to present a risk to juvenile fish, it may be possible to obviate the need to install screens on the new intake if it were constructed near the site and elevation of the existing AWS pump intakes. Lower Monumental Alternative No. 3, discussed on the following page, addresses this issue.

(3). North Shore Turbine Intake Screens

This option has many of the same problems as the gravity-feed system for north shore Ice Harbor, especially the problems associated with: air burst cleaning, balancing flow through screen, and the lack of cross-current to carry away the debris removed from the screens.

This may be a good site for a traveling screen.

b. Alternative 2 – Gravity Feed through South Non-Overflow Section

(2). Reservoir Water Intake System

(b). Drum Screen Intake

and

(e). Drum Screen Backflush System

If this idea would work, it would have some significant advantages over the systems proposed for north shore Ice Harbor. Some of the main concerns related to this alternative are:

a) What happens to the materials scraped from the outside of the screen by the UHMW shoes and brushes? There is insufficient current in the forebay near the screens to effectively transport the material removed from the screens.

b) What material(s), and what size of particles/pieces, is the vacuum/backwash system intended to remove? Algae? Sticks?

c) Will the backwash piping plug with debris?

d) It seems the debris-laden backwash water would be better discharged into the first spill bay rather than to be put in the water supply conduit. Why put debris in the flow upstream of the ladder diffuser panels?

e) There is concern that the sleeve valve will induce excessive vibration/noise in the water supply conduit. This could lead to additional delay of adult salmon and steelhead.

(3). Supply Conduit Connection

We are concerned about installing the sleeve valve on top of the water supply conduit. The vibration/noise may increase delay of migrating adult salmon and steelhead.

c. Alternative 3 - South Shore Supply Conduit Inline Pumping System

Alternative 3 provides a pump station with a deep intake in a location that is expected to contain only a small number of juveniles. Therefore, we expect that Alternative 3 can meet the objectives of this study while not creating significant additional risk to juvenile fish. We support the selection of Alternative 3 as the preferred alternative for the south shore at Lower Monumental.

NMFS Overall Comments

Table 1 shows the alternatives that NMFS recommends be adopted at Ice Harbor and Lower Monumental.

Table 1 - Recommended EAWS Alternatives

Project	Ladder	Alternative	Description
Ice Harbor	North Shore	2	Upgrade Existing Pumps, Upgrade Electrical and Improve Systems
Ice Harbor	South Shore	1 and 2	Electrical System Upgrade and Enhanced O&M
Lower Monumental	South Shore	3	Pump Station in South Shore Water Supply Conduit

The Corps has completed a thorough examination of a wide range of possible Emergency AWS alternatives. We believe the alternatives shown in Table 1 will best meet the objectives of ITS Number 16 in the 1995 BIOP.

Other Comments

The adult fishway systems at Ice Harbor and Lower Monumental have very significant backlogs of unfunded maintenance and repair work. The reliability of the fishways depends on the satisfactory operation of most of the equipment listed in the backlog. Therefore, completing the repairs on the unfunded backlog list and providing emergency auxiliary water supply are related efforts. It would be helpful to make that connection in the text of the report. Perhaps the list of unfunded maintenance could be included in an appendix.

Again, we have appreciated this opportunity to review the subject report. Please call Mr. Steve Rainey (503-230-5418) or Mr. Larry Swenson (503-230-5448) if you have any questions.

Sincerely,

M J Schneider

Mark J. Schneider, Ph.D.
Chief, Fish Facilities Branch
Hydro Program

May 19, 1999

Engineering Division

Mr. Mark J. Schneider, Ph.D.
Chief Fish Facilities Branch
National Marine Fisheries Service
Hydropower Program
525 NE Oregon Street
Portland, Oregon 97232-2737

Dear Mr. Schneider:

We very much appreciate your review and comments of the Lower Snake River Ice Harbor and Lower Monumental Projects Adult Ladder Systems Emergency Auxiliary Water Supply (AWS), Phase II Technical Report. In particular, we wish to thank Mr. Larry Swenson for his active role during the preparation of the report, and for his excellent ideas, many of which are incorporated into the report. His participation typifies the type of engagement we wish other agencies and tribes would offer at the Fish Facility Design Review Group.

Please note for reference, the National Marine Fisheries Service (NMFS) letter to the US Army Corps of Engineers (COE), Walla Walla District, dated 25 February 1999. Responses to the comments contained in your letter will follow the same sequence as the referenced letter. The content of the comments will not be repeated verbatim, but will be briefly paraphrased for reference.

SECTION 1 – INTRODUCTION

Comment: The comment pertains to the 1995 Biological Opinion requirement to develop auxiliary water for adult fishways, and the definition of what constitutes said requirement. Further, the NMFS agrees with the COE on the definition of the requirement and the approach methods initiated to meet the requirements.

Response: Comment accepted, the report attempts to follow the described logic.

SECTION 2.04 - ICE HARBOR – NORTH SHORE SYSTEM IMPROVEMENTS

Comment-1: The comment pertained to Alternative 1 (Criteria Revision with No Water Supply Additions, Upgrade Electrical and Improve Systems) and Alternative 5 (Reduced Entrance Width, Upgrade Electrical and Improve Systems). NMFS states these alternatives do not improve the reliability of the AWS study, and are therefor contrary to the intent of the report.

Response-1: These alternatives were explored in the report, but will not be recommended for further study or implementation.

Comment-2: The comment pertained to Alternative 2 (Upgrade Existing Pumps, Upgrade Electrical and Improve Systems). NMFS states that this alternative meets the intent of the study, and is the best North Shore Alternative at this time.

Response-2: Agreed, the COE intends to recommend this alternative in the report.

Comment-3: The comment pertained to Alternative 2 and enlarging Diffuser No. 1. The comment discusses the possibility of increasing flow using existing pumps, and the need to conduct detailed hydraulic analysis prior to installing larger pumps.

Response-3: The COE concurs with the comment. Continued and detailed hydraulic analysis will be necessary to determine the efficiencies, costs and benefits for this variation within the alternative. Further analysis will be conducted during contract preparation stages.

Comment-4: The comment pertains to Alternative 3 (Add Gravity Supply, Upgrade Electrical, and Improve Systems), and apparent inadequacy of the 500 cfs alternative to meet the Fish Passage Plan (FFP) under some tailwater conditions. Other design discharges could be studied as suggested in the comment.

Response-4: The COE concurs with the comment, and notes that the Phase II report has been revised to reference the Phase I report, which describes the reasoning to study the gravity feed option supplying 500 cfs.

Comment-5: The comment goes on to detail other specific concerns regarding the gravity feed alternative, including complexity, high O&M requirements, air-burst cleaning issues, debris removal, and vibration/noise with in the system conduits.

Response-5: The COE shares the same concerns. This alternative offers possible solutions to the concerns raised, as discussed in the report. Many of the solutions would require more intensive O&M procedures to ensure the system could function properly, which admittedly are not as desirable as other alternatives. The COE does not intend to recommend this option for further development.

Comment-6: The comment further states a traveling screen may be more appropriate for this screening application.

Response-6: A traveling screen system would need to address similar issues as noted above.

SECTION 2.07 - ICE HARBOR - SOUTH SHORE SYSTEM IMPROVEMENTS

Comment: The comment pertains to Alternative 1 (Electrical System Upgrade) and Alternative 2 (Improve Reliability through Enhanced Preventative Maintenance and Increased Spare Parts Inventory). The NMFS states that neither alternative alone addresses the intent of the study, and recommends both alternatives should be performed.

Response: Concur. Both alternatives have been combined into a third alternative. The COE intends to recommend this alternative in the report.

SECTION 3 – LOWER MONUMENTAL – 3.04 SYSTEM IMPROVEMENTS ALTERNATIVES

Comment: The comment pertains to Alternative 1 (South Shore Pumping System). The NMFS states that the proposed south shore pumping system has merit because it separates the north pump system from the south, thereby creating auxiliary water for the north shore system. The NMFS comment further discusses the measures necessary to reduce risk to juvenile fish due to the intake location.

Response: The COE agrees with the comments. The CC[illegible]oes not intend to recommend this option for further development due to the concerns regarding juvenile fish. However, if the recommended alternative cannot be implemented due to technical issues, this alternative could be implemented as a secondary option.

ALTERNATIVE 1 (SOUTH SHORE PUMPING SYSTEM)

North Shore Turbine Intake Screens

Comment: The comment pertains to the turbine intake supply system, and concerns regarding the proposed addition of a screened intake and air backflush system.

Response: Comment accepted. Project personnel have already modified the existing system. The addition of intake screens is not considered necessary and the details of the system have been deleted from the report.

ALTERNATIVE 2 (GRAVITY FEED THROUGH SOUTH NON-OVERFLOW SECTION)

Comment: The comment pertains to the proposed separation of the existing adult fishway system and supplying the south shore via a gravity feed water supply through the south non-overflow section. The NMFS expresses concerns regarding forebay mounted screen systems, the ability to keep the systems clean, and potential for noise/vibration could be introduced into the conduits that may cause delay adult salmon and steelhead.

Response: The COE shares the same concerns. This alternative offers possible solutions to the concerns raised, as discussed in the report. Many of the solutions would require more intensive O&M procedures to ensure the system could function properly, which

admittedly are not as desirable as other alternatives. The COE does not intend to recommend this option for further development.

ALTERNATIVE 3 (SOUTH SHORE SUPPLY CONDUIT INLINE PUMPING SYSTEM)
Note: The above alternative was created after the preparation of the 90% review document, as developed with the NMFS on 13 January 1999, and as presented at the FFDRWG meeting on 28 January 1999.

Comment: The comment pertains to the an alternate location for a deep tailrace intake to supply the south shore system. The NMFS states this alternative is expected to meet the objectives of the study, and not create significant additional risk to juvenile fish, and therefor supports this alternative.

Response: Concur. The COE intends to recommend this alternative in the report, and appreciates NMFS coordination in developing this alternative.

NMFS Overall Comments

Comment: A table was provided by NMFS that indicates preference on which alternatives are recommended. Ice Harbor North Shore; Alternative 2. Ice Harbor South Shore; Alternatives 1 and 2 combined. Lower Monumental South Shore; Alternative 3.

Response: The COE agrees with the NMFS on the recommended options.

NMFS Other Comments

Comment: The comment pertained to backlogs of unfunded maintenance and repair work on the adult fishways at Ice Harbor and Lower Monumental Dams. It was noted that the reliability of the fishways depends on the satisfactory operation of the equipment.

Response: The COE agrees with the comment. Specific reference to O&M items are included in the body of the report and in Appendix G, to emphasize the importance of the maintenance. The report discusses the separation of new systems required to bring fishway auxiliary water into compliance with the present FFP, but defines O&M as a separately funded, but equally important element to ensure system reliability.

We appreciate your comments and assistance in the development of this report. Please contact Mr. Kevin Crum at 509-527-7557, if you have questions or comments.

Sincerely,

/s/ DAFREI

DOUGLAS A. FREI
Acting Chief, Engineering Division

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
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F/NWR5

JUN 29

Mr. Rick Emmert
Technical Manager
CENWW-ED-D
U.S. Army Corps of Engineers
201 N. 3rd Street
Walla Walla, WA 99362

Subject: Review of Draft "Lower Snake River Projects Adult Ladder Systems Emergency Auxiliary Water Supply Phase II - Technical Report"

Dear Mr. Emmert:

We appreciate the opportunity to review the draft of the Ice Harbor section of the subject report which was forwarded in your memo of May 4, 1998. Our comments are provided in the following sections of this letter.

1.0 GENERAL COMMENTS

1.1 Emergency AWS Goals

Incidental Take Statement (ITS) No. 16 of the 1995 Biological Opinion (BIOP) states:

> The COE shall develop emergency auxiliary water supplies for all adult fishways where determined, in coordination with NMFS, to be necessary. Emergency supplies are needed to maintain fishways within optimum criteria for passage in the event of turbine or pump failure.

The performance goal for the Emergency Auxiliary Water Supply (EAWS) systems is that the EAWS should meet the normal Fish Passage Plan (FPP) operating criteria in the event of a pump failure in one or more AWS pumps. The phrase "pump failure" refers to any combination of mechanical, electrical, hydraulic or structural problems that prevents normal operation of an AWS pump. The intent of the ITS is to ensure that the AWS systems are sufficiently reliable and flexible to ensure that there is a very low risk that equipment failure will result in the inability of the AWS to meet flow and head criteria.

The BIOP does not necessarily require construction of a completely independent and separate source of AWS water. An independent and separate water supply should only be considered if the existing system cannot be modified to provide sufficient reliability, redundancy or spare capacity.

1.2 Principal Concerns

Our principal concerns with the draft report are as follows:

1) The report should address the risk of failure of the vital components of the AWS, and discuss the most likely failure scenarios.

2) The report should show how each of the proposed EAWS alternatives offsets the likely AWS failure scenarios.

3) The report should define the performance requirements of the EAWS for the north shore and south shore fishways. The design flow rates, range of tailwater elevations, duration of operation, and impacts on adult and juvenile fish should be discussed.

4) The report assumes that spare pumping capacity and enhanced maintenance are equivalent to an emergency water supply. The report should show how these actions would meet the requirements of an EAWS.

If the existing equipment is to be used as an emergency system, then the Corps must prove that there is sufficient spare hydraulic capacity and electrical redundancy to satisfy both the risk criteria and the emergency flow criteria. The risks associated with using the existing mechanical and electrical equipment as integral components of an Emergency AWS system must be carefully scrutinized.

The comments on the individual Ice Harbor alternatives are presented in the following sections.

The preceding general comments also apply to the upcoming reports for Lower Monumental, Little Goose, and Lower Granite.

2.0 NORTH SHORE AWS

2.1 North Shore Alternative 1 - Operational Changes and Equipment Upgrade

Alternative 1 involves changing the Fish Passage Plan (FPP) adult ladder criteria to authorize reduced attraction water flow rates at lower tailwater elevations. The NMFS does not concur with the concept of reducing the flow rates that are presently specified in the FPP in order to match the capacities of the installed pumps.

2.2 North Shore Alternative 2 - Increased Pump Capacity and Electrical Redundancy

The NMFS believes that Alternative 2 has the potential to significantly improve the reliability of the north shore AWS system and its ability to meet FPP flow criteria. However, the report should include a discussion of the capability of the present system. We analyzed the daily fishway hydraulic data for 1996. It appears that the system met criteria only about 50% of the time, even when the tailwater elevation was sufficiently high to create 8 feet of submergence. We did not have the daily record of which pumps were in operation. At any given tailwater elevation, the criteria could be met on some days and not met on other days. A detailed review should be conducted to determine how many pumps are required to meet criteria during low, medium, and high tailwater elevations. A spot check of the 1997 weekly inspection reports indicates that three pumps may be operated almost all of the time, regardless of tailwater elevation. The 1995 Corps report "Hydraulic Evaluation of Adult Fish Passage Facilities at Ice Harbor Dam" concluded that "the pump head is 1.5-2.0 feet higher than the design level. This indicates that there may be some obstruction in the water supply conduit or that the diffuser system is under designed." The water supply conduit was surveyed by a Remotely Operated Vehicle (ROV) last winter. No obstructions were found.

This alternative includes a proposal to modify the diffusers to reduce head loss and increase flow rate. A detailed hydraulic analysis would be required to ensure that the flow balance between the upper entrance pool diffusers (Nos. 2 - 9) and the main floor diffuser (No. 1) is maintained throughout the range of tailwater elevations, and number of operating pumps.

The concerns raised in the previous two paragraphs indicate that a more detailed hydraulic analysis of the north shore AWS system should be performed to ensure that we: 1) have a thorough understanding of the hydraulic performance of the present system, 2) can estimate how the diffusers should be modified, and 3) can accurately predict how the modified system will perform with new higher-performance pumps.

2.3 North Shore Alternative 3 - Gravity Feed Through North Non-Overflow Section

The gravity feed system shown in Alternative 3 represents a complete, stand-alone AWS system. It could operate continuously for indefinite time periods. As indicated in the drawings, a juvenile screening system would be required. A trash rack system may also be required to protect the screens, which was not shown in the drawings. Screen cleaning and flow balancing for either the passive or active system would be problematic. Overall, we believe that Alternative 3 would significantly increase both the complexity and the O&M costs of the AWS system. The existing pumps would still need to be refurbished and the electrical system upgraded.

The fish ladder water temperature issue that is currently being studied at several projects may give added impetus to Alternative 3 if the research demonstrates that a gravity feed auxiliary water supply could improve a water temperature problem.

2.4 North Shore Alternative 4 - Barge-Mounted Pumps

We concur in your recommendation to not pursue the barge-mounted pumps concept.

2.5 ADDITIONAL NORTH SHORE CONCERNS

The present procedures for providing crane service at the north shore AWS pump station is to lower a crane from the navigation lock roadway onto the pump station deck. This process significantly expands the time required to troubleshoot, maintain, anc repair the AWS pumps. The Corps should install a dedicated crane at the north shore AWS pump station.

3.0 SOUTH SHORE AWS

3.1 South Shore Alternative 1 - Enhanced Maintenance Program

Our general comments, contained in Section 1.0, also apply to the south shore facilities.

The report should include a discussion of the capabilities and limitations of the existing south shore AWS system. A spot check of the 1997 weekly fishway inspection reports indicates that sometimes as many as seven or eight pumps are operated to meet criteria. This would indicate that there is no spare pumping capacity under some tailwater conditions. Our review of the 1996 daily fishway data indicates that the south shore system nearly always meets criteria when the tailwater is above elevation 340.5. However, we could not tell from the data how many pumps were operating.

We also request a more detailed examination of the hydraulics of the south shore system, including a rating curve of the total head between the tailwater and pump discharge chamber for low, medium, and high tailwater for various pump combinations under the existing conditions and when operating in emergency mode. The report should propose and justify a design backup flow rate capacity for the south shore AWS based on the above analysis.

The south ladder must have the lowest possible risk of shutdown. An analysis of the risks of ladder outage due to mechanical, control, and electrical casualties should be conducted and presented in the report. The selection of emergency backup alternatives should be based on the risk analysis. It may be necessary to install additional pumps or provide a gravity-fed system.

3.2 South Shore Alternative 2 - Electrical Upgrade and Redundancy

The comments for Alternative 1 apply for Alternative 2.

Please call Steve Rainey (503) 230-5418 or Larry Swenson (503) 230-5448 if you have any questions.

Sincerely,

Mark J. Schneider, Ph.D.
Chief, Fish Facilities Branch
Hydro Program